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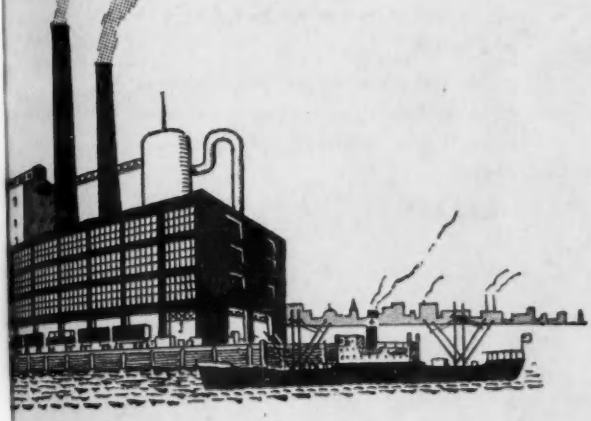

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ECONOMIC GEOGRAPHY

VOL. 29 JULY, 1953 NO. 3

REGIONAL RESEARCH—EMERGING CONCEPTS AND TECHNIQUES IN THE FIELD OF GEOGRAPHY*

Edward A. Ackerman

Dr. Ackerman, Assistant General Manager of the Tennessee Valley Authority, is on leave from the Department of Geography, University of Chicago.

I SHALL make no claims, in what I have to say, for the reservation of any special province in regional study for geography. Geography or any other field of research has claim to a place only in proportion to the number of ideas it produces and the results it records. If we have any need for security I would seek it not through the territory we can defend, but in the ground which we can break.

Even though they lay no special claim to the region as their preserve, geographers have had a long, and at times distinguished, history of studying the region. Regional study and analysis has been a recognized part of geographic thought for more than 200 years. In its modern form regional study has been a part of our work in this country for at least 50 years. No geographer of this day would deny the existence of a region, as at least a few students in other disciplines have. There are some who despair of ever reaching a full understanding of a region, but there are none of my acquaintance who refuse to see its existence. In the end I believe that the efforts of our profession reach their highest good in the contribution they make to a final understanding of regions—regions as a part of man's life and activity on earth.

Perhaps the first need in discussing this subject is a passing comment on semantics. In the course of 200 years it is natural that we should have found a number of different uses for the word "region" or its equivalent in other languages. My purpose here is to discuss what many geographers have come to label a "geographic" region. I shall not refer to the myriad forms of single purpose regions—whether those single purpose regions are administrative, trading area, soils, climatic, or any one of a hundred other forms.

I shall speak, then, of that composite phenomenon which has resulted from man's occupance of the earth—a distinctive spatial grouping of similar attributes of that occupance. One might say that a region is a particular expression of the attributes and limitations of a culture, observable as they relate to the earth's space and physical composition.

There is no point in recognizing the existence of "geographic," or composite regions unless there is some beneficial result from studying and

*Paper given at the meetings of the American Association for the Advancement of Science, St. Louis, Missouri, December 30, 1952.

interpreting them. In this instance I would recognize those beneficial results which have either academic value or immediate practical use. That is, they can serve either to extend the scope of our knowledge, or they can make the approach of our society to a better ordered existence more certain. Working concepts in research must be related to those beneficial results. To discuss concepts and even techniques intelligently one must define the general objectives of regional study clearly. I believe that an important beginning step in this connection is to understand that any region has a time dimension as well as a space dimension. Past geographical research has brought forth numerous studies of regions of various orders, from those covering the neighborhood locality of a city to others on a continental scale. Many of them have explored the space dimensions thoroughly and treated those dimensions adequately. But until a relatively few years ago those studies too often had the quality of snapshots when one examined the time dimension. They recorded the expression of a culture frozen in space at a given moment in time. It was difficult to discern any clearly defined beneficial result from those regional studies except insofar as they served the use of historical records. More recently geographic research workers have explored the time dimension, in its extent into the past, through the techniques of historical geography and through the simpler special technique of studying "sequent occupance." In either case knowledge of the evolution of a region is the immediate objective. Such study may seek the remotest antiquity and end still in antiquity, like some of the careful studies done from the inspiration of Carl Sauer at California. Or they may explore only those more recent stages of the past which are thought to lead to an understanding of the present region. This research may concentrate on the evolution of the landscape, as in Whittlesey's technique of sequent occupance, or it may cover the spatial attributes of some of the less tangible aspects of a culture, as in some other studies of historical geography.

Geographers also have been interested in exploring the time dimension in the other direction, into the future. Our work here has accompanied the recognition given by some geographers to the potentialities to be realized from the practice of regional planning. The work of Charles C. Colby, Harlan H. Barrows, Gilbert White, and others who participated in the work of the old National Resources Planning Board may be cited as an example of the effort to extend the time dimension of the region in the direction of the future. It was no accident that Professor Barrows, for many years an incisive contributor to historical geography, was also for more than 20 years an important contributor of geographic thought to the planning process. White's more recent attention to American water resources, and my own work on Japanese natural resources and American water resources, may be cited as further examples of work which seeks to extend the time dimension. Properly undertaken, I believe that such effort contributes to an understanding of the present no less than attention to the past region. It is our understanding of the time dimension which has made us thoroughly understanding of and sympathetic with the efforts and thought of the regional planner.

If one concedes that the time dimension is an essential part of regional analysis the focal objective of regional

research becomes much clearer. I believe it to be a definitive description of the social and physical forces which shape a region in time, as they react on each other. This is the reality to be sought, and in proportion to our grasp of it, we may have some claim to predictability. This is an objective of the greatest social significance, and for regional research I do not believe that there can be any other final objective of primary significance. Behind this objective there lies the thought that, given knowledge, we can mold those forces for a better society. I believe that it is a logical academic objective as well as a socially practical one. However, my professional colleagues will be the first to admit that the road is long and the route devious toward this objective.

We are far from the definitive description which I mentioned. Considering the small present number of students of regional structure, we may never reach that understanding for many regions. One of the best proofs I can offer concerning the state of affairs is shown in regional resource development programs, which have need of regional analysis probably more than any other activity of the day. Yet, if you were to ask the officials responsible for the administration of the important programs why they choose certain courses, they would reply that not infrequently they act on faith rather than on a completely reasoned factual basis. The facts from thorough regional analysis are not there.

Recognizing the goal which is the logical end of regional analysis, are our present ideas and techniques suited to at least some progress in that direction? I believe that there are some signs of promise from every quarter in which students are thinking of regional analysis. Most notable is the increased interest on the part of some economists in regional analysis. I can report that geographers also share in the development of ideas and techniques which will promote some progress. The 1952 study by the geographers' committee of the National Research Council provides interesting evidence of our thought.[1]

EXAMPLES OF PRESENT-DAY CONCEPTS

I shall discuss illustrative examples of both concepts and techniques. Of each I shall offer four.

First the four concepts.

In regional study it should be recognized that:

(1) There not only are regions but there is also a hierarchy of regions. We should define these spatial units of different order in better manner than we have, and design our research so as to take account of the results which can be obtained from the examination of several levels at the same time.

(2) The totality of a region may never be a practical goal for analysis; instead we should concentrate our attention on developing our knowledge of key features in regional analysis. In the words of the committee of the National Research Council, "It appears to be sound practice to restrict the inclusiveness [of regional study] to the community of features that depict the human occupance of area."[2] The committee proposes that we use a new term "Compage" for this type of region, which is something less than regional totality, but which keeps us within the bounds of our present capacities. De-

[1] The National Research Council report "Regional Study with Special Reference to Geography" (National Research Council Division of Geology and Geography, Washington, D. C., 1952, 74 pp.) is acknowledged as the stimulating source of some ideas expressed here.

[2] *Ibid.*, p. 37.

velopment of the most meaningful possible compage then is the immediate objective of study.

(3) A reaffirmation of the uniqueness of all regions on the face of the earth. I find this well illustrated academically in the National Research Council committee's assertion that for geographers' study of the compage "no standard list of criteria [can be] adopted as universally suitable for differentiating compages [prior to field observation]."[3] We find it further well illustrated practically in our national political life—in the controversy which has arisen over the development of water resources in the several parts of the country. We also find it illustrated internationally in the application of ideas of economic development conceived in this country, but either brought to earth or evaporated in a foreign land.

(4) There are two distinct classifications of regions, the near-uniform region and the nodal region. Our understanding of the nodal region is far from having the background necessary for adequate treatment, even though it may be the dominant one in human occupance. It therefore becomes clear that attention may well be centered on developing the concept of regional cores and broad boundary zones rather than on perpetuating the convention of setting exact limits to regional boundaries and examining distributional phenomena within those boundaries. The nodal region may prove to be the region of most significance for the objective I have described.

TECHNIQUES

I also have four points of technique to discuss:

(1) Geographers share the trend in other social and physical sciences of encouraging to the utmost quantitative analysis. Our feeling for quantitative presentation is as old as maps are, for a true map is always an instrument of quantitative presentation. Our best recent efforts in this direction have been toward further refinements in cartographic technique, and in some work directed toward increasing the usefulness of census materials.

(2) No single student can be considered an effective contributor with the totality of one region as his special area. Intensive topical study as it relates to the region is the clue to effective research. It therefore follows that:

(3) Regional research is a task for a team of research workers rather than any one.

(4) The use of inter-regional comparison probably has some particular unexploited values in leading us to an understanding of the forces at work in shaping a region or regions.

I shall not comment on all of these, either concepts or techniques. Space does not permit me to mention more than two or three in detail.

THE HIERARCHY OF REGIONS

The National Research Council Committee has called attention very definitely to the need for a better understanding of the hierarchy of regions. The Committee suggests that we should seek to develop a suitable system which would characterize the different levels of what it calls "subdivision and aggregation."[4] To illustrate its point it suggests that there are five different orders of regions: localities, districts, provinces, realms, and grand divisions. North America east of the 100th meridian and south of the St. Lawrence might be one ex-

[3] National Research Council, *op. cit.*, p. 38.

[4] *Ibid.*, p. 41.

ample of a grand division, the Great Basin and the Great Plains probably an example of a realm. Southeastern United States might be considered a province. Whatever the categories chosen as definitive in such a system I believe that the recognition of hierarchy is a step in the right direction. If we are to throw light on the interaction of social and physical forces as they shape regions in time it is important to understand that we shall have to have research which examines characteristics of all levels of region. In recent years many of us have operated on the theory that to understand a larger region we first must have intensive studies of the smaller regional units of which it is comprised. During that time micro-geographical studies have amounted to a great deal of the research undertaken in geography. There have been students who have worked with the larger region but effective performance in that area certainly has been a lesser part of the total output. Yet we are now coming to appreciate that concerted examination of several levels of region is needed to throw light on the interaction of social and physical forces as they shape regions.

I shall offer one or two practical examples of the need for attending to the larger region along with studies of the smaller.

One of the influential forces shaping some regions in the United States, and now in the world, is induced development of natural resources through socially or governmentally organized action. My own agency, the Tennessee Valley Authority, probably has been the outstanding example of such an undertaking. One might almost say that the TVA had created a region. Certainly it has brought some latent features of the interior South into bold relief by creating a new focus for economic activities. I believe that TVA has been both efficient and successful—it has proven itself as an effective beneficial force. Yet it remains a lone example in the United States of this form of development. This remains true despite two notable attempts in western United States to establish forms of development similar to TVA. The failure of those two attempts in the Columbia and on the Missouri have been taken in some quarters as an implied rejection of the TVA form.

I do not want to argue one way or another as to the applicability of the TVA idea and form to the western United States. However, I think that TVA's example has influenced what has taken place in the West in recent years more than most students realize. TVA also has proven itself admirably as a basic instrument for rehabilitating an underdeveloped area of deteriorating resources and increasing population in a humid physical environment. I believe further that some of the concepts used in TVA can have almost universal application where induced development is sought. The real question comes in the extent of detail used in applying the pattern. If we were to study western United States as a realm, or one order of region, as contrasted with the eastern United States we might find some important clues as to the suitability of one pattern or another in each of those environments. I am mindful of the fact that even offhand the West has many notably different aspects from the East when it comes to questions of water management. Where water is concerned, traditions of distribution, of engineering, and of administration differ notably in these two major parts of the country. Not the smallest difference is the important one found in western and eastern water

law. It seems to me that one must start from thorough examination of such general attributes of the broader region before he can have a convincing answer as to the pattern adapted to any one river basin in the region. We do not understand the magnitude of social and physical forces at work nor their potentialities unless we do this.

Attention to the existence of regions of different order, then, is one need. Another useful result from keeping the hierarchy of regions in mind is that it may serve to bring out the relations of the forces, or potential forces, of one region in their affects on another. In TVA we are coming to appreciate, for instance, that a more intimate knowledge of what is happening in the areas which surround the TVA watershed and power service area can be very useful in planning effectively for future development in the region. I do not believe that we can understand the region as it develops, for instance, unless we know what lies behind the fingers of the midwestern manufacturing belt which are commencing to extend into the Tennessee Valley region. Likewise developments in the petroleum and gas fields of the Gulf Coast also may have far-reaching economic effects on the Valley.

This relation is of interest in another direction. The nation would be the better, for instance, for knowing what the effect of the induced development of the Valley has meant to other regions in eastern United States. In this connection the Tennessee Valley often has been accused of taking industry away from New England. Yet if we were to examine the facts of the case, we probably should find that exactly the opposite is true. One need only examine the vastly increased market for electrical appliances alone brought about through the Valley development, and the need for machines in the growing industry of the Valley. He then realizes that New England communities, and even Boston financiers, must have profited from what has taken place in the Valley.

KEY FEATURES IN REGIONAL ANALYSIS

If we are to examine the larger regions along with the smaller units, the search for key features in regional studies assumes particular importance. Here we probably have much to learn. But we also have carried on much interesting work in the past. Our attention to the fields of water and energy resources have been particularly intensive as they related to the life of the region. However, the work of Edward Ullman in the regional analysis of transportation and his interest in the amenities as a force in regional development are also deserving of recognition. The interest of Lawrence Durisch of TVA and others in the Southeast in studying community amenities is a further example.[5]

I have faith in the usefulness of the key feature, because when one touches such a feature he reaches into a broad area of human action and human experience. Ullman quotes Professor Stuart Dagget of California in this connection: "Most of those who have dealt with the function of transport . . . have been economists . . . yet the longer that I have worked with transport problems the more I have come to feel that the subject of transport, comprehensively considered, runs across the

[5] See "Local Government Services and Industrial Development in the Southeast," Joint statement by the University of Alabama, University of Florida, University of Georgia, University of Kentucky, University of Mississippi, University of North Carolina, University of Tennessee, and the Tennessee Valley Authority, University of Alabama Press, 1952, 27 pp.

thread of human experience. History, psychology, the peculiarities of government, the associations and migration of people, as well as the fertility of land and the techniques and organization of industry are concerned."[6] The same can be said for the field of water resources. Certainly those of us who have examined it know that it is a short step from studying water resources to social philosophy and political controversy!

Probably the principal identification of a key feature is the breadth which it commands in its normal inter-relations with other activities and life in the region. Yet I would hasten to add that our search should extend beyond the breakdown of the order which I have already mentioned, as in water resources and transportation. With regard to each of them we should seek those details which mean the most, and eliminate those aspects which are incidental. I am convinced, for instance, that the subject of electric power rates is a key feature for the study of electric energy. The subject of transportation rates likewise is a key feature for transportation. Each of you can probably think of other important details. The significant thing is that we probably need not look over every aspect of water and energy resources and every aspect of transportation in order to understand those two activities as forces shaping the life of the region. We should cut a path rather than attempt to fell the whole forest.

I can suggest other areas within which we should look for the key features but I would not suggest that we have the answers within any of them: land use, and the activities and natural features influencing it; population, technology, labor force, and income; legal and administrative systems; industry and finance; social organization, traditions and customs. In all these there is the material for understanding the forces which shape a region. Can we isolate enough from within each of them to make the larger region as well as the smaller region manageable for the regional analyst? I admit that we are in difficulty, but I am far from admitting that we are defeated. I shall not be willing to admit defeat, or think that we are doing our best, until we have explored thoroughly the problem of identifying the key features for regional analysis.

[6] Edward L. Ullman: "Human Geography and Area Research," University of Washington, Seattle, Washington, 1952 (mimeo.) 9 pp.

TECHNIQUES

If the search for key features is an important part of a regional analyst's problem at this time, a few words about techniques are in order.

THE TOPICAL SPECIALIST

The efforts of the topical specialist who works with a recognition of a regional framework are particularly needed. I do not believe that the man who specializes on a region, per se, can ever give us the answers. As far as research is concerned he is an outdated man. In this capacity he may be a successful teacher or administrator, but unless he steps out of that role and into a topical specialty his research efforts will not necessarily go in the direction in which we need to go. It is not so much a question of topics of the general category with which we have been accustomed to deal in the past and their selection and interpretation. Instead it is a question of the particular aspects of those studies which are indicators and manageable measures of the forces we seek to understand. On the other hand, I believe that the topical specialist who ignores or minimizes the breadth of topics which

should serve as his proper background for research will not be particularly useful either. That was the reason that I isolated the topical specialist who works with recognition of a regional framework.

INTER-REGIONAL COMPARISON

One reason I am interested in the topical specialist is because I am interested in wider use of the device of inter-regional comparison. To be meaningful this is now possible only by topical specialty.

I should like to suggest greater attention by all disciplines to inter-regional comparison. Spatial comparison, of course, has been a central feature of geographical study from its beginning. The map, which is still our best developed tool of research and presentation, is essentially an instrument of comparison. We have made some comparative studies of regions of a more complex nature than generally are indicated on a map, but they have been fewer than many would like to see. We have had an illustration of the benefits from such study recently in the TVA in some county income studies, which were completed in cooperation with southeastern universities.[7] This is essentially a study of comparison which has proved to have many unsuspected uses both within TVA, in businesses, in state governments, and for academic students of the region.

On a somewhat larger scale I believe that most of you here can readily appreciate the meaning of results which might be obtained from a study of land reclamation in regional settings of eastern and western United States. I would commend for your attention also the value of a thorough regional study of the power rate structure of the United States. If we are interested in understanding the forces which are at work in shaping our regions, here, certainly, are two topics of deep significance. I believe that the best beginning to an understanding of them can come through regional comparison.

I should like to summarize some part of my comments:

(1) We should consider the region as a product of social forces and physical forces interacting in space. The regional analyst's most fruitful direction for investigation is in orientation to the region as a dynamic entity.

(2) We might recognize that if we understand the interaction of social and physical forces in space we have on the one hand a sound background for understanding nations or cultures; and on the other hand we have a sound basis for formation of public policy.

(3) We may recognize that for regional study, dealing with the totality of the region is about the same as seeking the whole truth in philosophy. We should recognize frankly that we are dealing with a part of the whole, or a *compage*, as the National Research Council's committee expressed it.

(4) We should seek some systematic identification of compages, or of these partial regions, as they exist on the earth. At least, we should seek some systematic identification of such regions as they exist in this country.

(5) We should recognize that we do not yet have regional study reduced to manageable proportions. We should concentrate our attention on topical study in an effort to seek out the key features which can be used for effective description and interpretation of regions.

[7] J. L. Lancaster: "County Income Estimates for Seven Southeastern States," Bureau of Population and Economic Research, University of Virginia. Charlottesville, 1952, 246 pp.; and L. C. Copeland: "Methods for Estimating Income Payments in Counties," Charlottesville, 1952, 108 pp.

(6) I commend to your attention an examination of public policy issues, as a fruitful area in which to begin looking for key features in regional study. I further commend your attention to an examination of induced regional development of natural resources in the United States as a pertinent public policy issue in this connection. I recommend it because it stresses the living dynamic region; because it gets away from emphasis on physical appearances; and because resource development has need of continuing regional analysis if it is to be maintained at peak efficiency. We would welcome such attention in the Tennessee Valley, where we believe that it might be a good opportunity for testing some of the approaches and methods in the social sciences. The Valley may even present a unique opportunity for some years.

While I would have us enlarge our scope, I am mindful that the world is not yet our oyster. I would look, therefore, for the places where we are most needed and seek to develop our theory as we work on the practical.

CHANGING THE MAP OF THE SOVIET UNION*

George B. Cressey

Dr. Cressey is Maxwell Professor of Geography at Syracuse University. He traveled widely in the Soviet Union in 1923, 1937, and 1944.

WHENEVER I have asked a Russian geographer to define the subject, he has invariably replied: "The function of geography is to develop the productive resources of the State." As with most Soviet science, there is little room for cultural aspects; geography must be practical. This is reflected in the large number of geographers employed in every planning board.

The utilitarian concept of geography finds its basis in dialectic materialism. Karl Marx and his followers conceived of nature as in constant process of modification by man. These changes proceed according to fixed materialistic principles, including the transition from feudalism through capitalism and socialism to a communist economy. Only in step with these social changes can nature be modified.

The natural environment is not a constant, and the power to direct its development lies with man. Geography thus becomes a tool in the communist reshaping of nature and the redistribution of productive forces. All of us recognize man's ability to modify nature, but we do not all follow the Soviet line that complete control is only possible under communism. This ability to reshape nature includes the alteration of any natural situations which restrict crop production or economic development. The possibilities are thus limitless, and the place of geography in state planning becomes obvious.

The Soviet Union operates under a planned economy. Private initiative is eliminated, and the resources of the state are devoted to those undertakings and in those places which are thought wise. The results are not perfect, but five successive and generally successful Five Year Plans, plus victory in war, make it clear that the U.S.S.R. has very great capacity to meet high goals.

Their ultimate objective is to create a communist state. Today, however, the Union operates under a socialist rather than a communist economy. To achieve her goals, the Soviet government is engaged in transforming the map, and in reshaping nature wherever necessary. It is clear that they are audacious, and that they may point to considerable success. It also seems obvious to a geographer that they face major environmental restrictions, and that there are practical limits beyond which it is not feasible to go.

The only limit to man's use of the earth lies in his ingenuity and the amount of effort which he is prepared to invest. But it should be clear that with the same skill and investment, the returns will be larger in more favorable environments. The United States of America enjoys assets of climate, soil, minerals, and location which clearly outweigh those of the Union of Soviet Socialist Republics. If the two peoples

*Presented before the Association of American Geographers at Cleveland, March 31, 1953.

FIG. 1.

have equal technical ability, patriotism, and determination, America will surely keep in the lead. The only way in which the Russians can overtake us is by harder work and more sacrifices than we care to invest.

One reason why the Union probably wants to avoid another world war is so that she may further narrow the difference between socialist and capitalist production. Each year their industry is expanding faster than our own. One reason for this is that Soviet economy plows back a large part of its income into further plant investment rather than devoting it to consumer welfare. This brings a rich reward in terms of gross national product.

In 1952, the Union claimed an 11 per cent increase, but this should be compared with the 16 per cent gain which they claimed for the preceding year. Both figures are regarded as too high by American economists, who propose an actual 7 per cent gain in the gross national product. Whichever figure may be correct, a major factor is manpower. Soviet factories have been absorbing workers at the rate of two million a year, but in 1952 the number was reduced to half that figure. By 1960, it seems likely that industrial production will taper off, and at a level very much below that of Western Europe or America.

Production data for recent years are shown in Table I, with figures in millions of tons, except for electric power which is in billions of kilowatt hours.

TABLE I

SOVIET BASIC PRODUCTION

	1940	*1950*	*1952*	*1955 Goal*
Coal	166	260	301	372
Oil	31.0	37.8	47.4	69.9
Pig iron	15.0	19.4	25.2	34.1
Steel	18.3	27.3	34.4	44.2
Electric power	48.3	90.3	117.0	162.5

The U.S.S.R. is now in the midst of its Fifth Five Year Plan. Earlier programs, dating from 1928, have already transformed the face of the

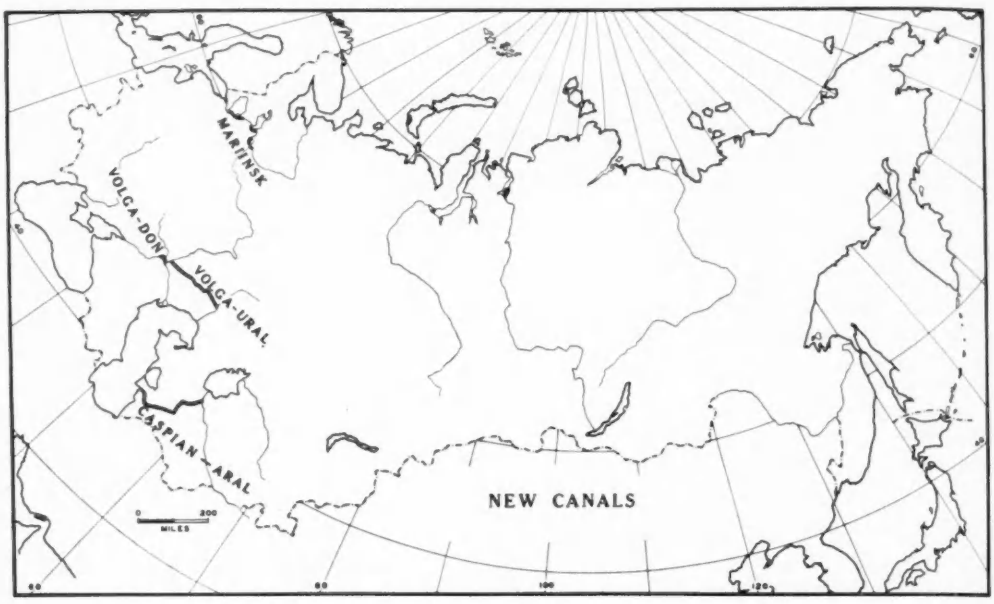

FIG. 2.

country and have advanced the Union to a significant place in world economy. Between 1951 and 1955 the current plan proposes to expand industrial production by 70 per cent, increase the harvest of grain by 45 per cent, enlarge retail trade by 70 per cent, increase rail freight by 35 to 40 per cent, and double air transport. While the labor force will expand by only 15 per cent, its productivity is scheduled for a 50 per cent increase. With all these developments, the U.S.S.R. will still be far behind the U.S.A., although the gap is closing.

The announced program of the Fifth Five Year Plan includes both generalities as to percentage increases for various industries and specific details as to some individual operations. The exasperating character of Soviet data is well known; it is also true that much can be learned from careful search. Many engineering works are included in the Plan, but details and locations are unavailable. The programs here considered include some which were initiated in earlier years and currently being completed, new projects which will be finished by 1955, and other large-scale developments to be started now but which will take additional time for completion. This article deals with those projects which are capable of being mapped. These may be grouped under transportation by rail or water, irrigation and drainage, climatic modification through shelter belt planting, and the development of hydroelectricity.

TRANSPORTATION

Railways

The Fifth Five Year Plan gives relatively little attention to additional railroad mileage. This is all the more surprising in terms of the extensive railways construction of earlier Plans. The South Siberian line is to be completed, thus providing a direct link between Magnitogorsk, Kuznets, and the Yenisei. Other lines in Middle Asia will complete the coarse grid of this area. An additional 600 kilometers

of the Trans-Siberian is to be electrified. No data are available on the long discussed railway north of Lake Baikal to the Pacific, called the BAM. The two ends of the railway are known to have been operative a decade ago but they are not shown on any Soviet maps.

Water Transport

Water transport has always been significant in Russia, but many of the rivers flow in the wrong direction and all of them enter seas which are ice blocked for part of the year. Not a single river is usable the year around. The Volga carries the major trade, but ends in the landlocked Caspian. Plans call for a national increase in water traffic between 1951 and 1955 of 75 to 80 per cent. Major stress is placed on linking the existing waterways.

First in importance among the new waterways is a large canal, near Stalingrad, which links the Volga with the Don. This provides access from the Union's greatest river and the landlocked Caspian to the Black Sea. The canal has been under consideration for decades and is a major engineering accomplishment. Construction was especially difficult since the canal must rise over a high ridge. The Volga at this point is below sea level.

The Volga-Don Canal is 62 miles long, and has 13 locks, generally with a 30-foot lift. The total rise on the Don side is 145 feet, while to the east of the divide the canal drops 290 feet to the Volga. The locks are 460 feet long, 60 feet wide, and have a low water depth of 15 feet. Two additional locks are located on the Don below the reservoir, known as the Tsymlyanskaya Sea. This reservoir will reach 216 miles upstream, and is held back by an earthen dam, seven miles in length, which raises the level of the Don by 85 feet. Water for both sides, and for irrigation, is pumped from the Don

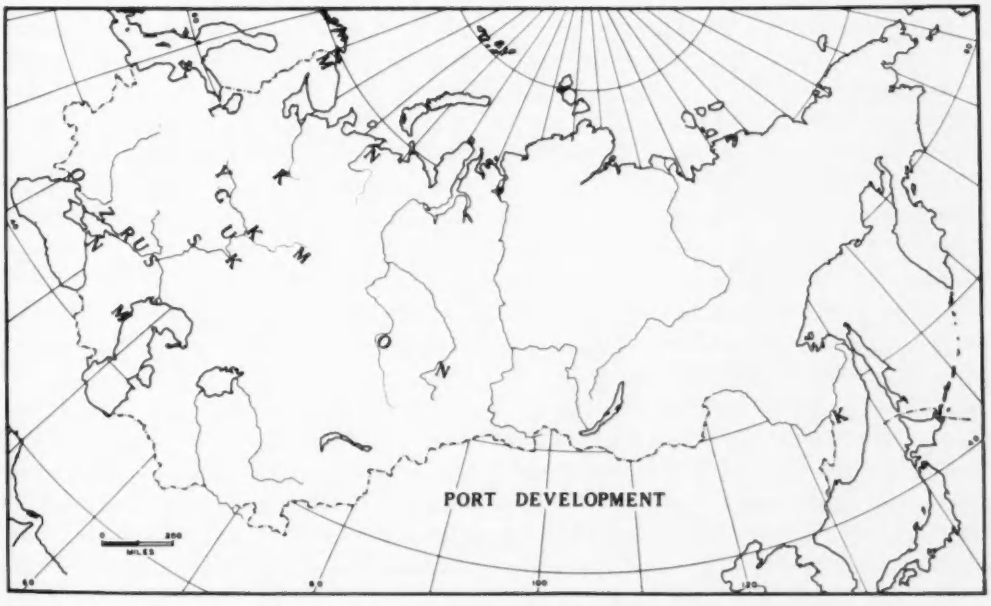

FIG. 3. The 20 ports whose facilities are to be doubled are: Murmansk, Kotlas, Naryan-Mar, Leningrad, Yaroslavl, Gorki, Kazan, Molotov, Ulyanovsk, Kuibyshev, Saratov, Stalingrad, Rostov, Zhdanov, Odessa, Novorossiisk, Makach Kala, Omsk, Novosibirsk, and Khabarovsk. A new port is to be built at Ust-Donetsk at the junction of the Donets and Dnieper Rivers.

River by electric power produced at the new dam.

Through this canal, coal from the eastern Donets Basin may move by water into the Volga and Caspian area, while oil may be shipped to the west. Grain, lumber, ores, and manufactured goods will add to the traffic. Unfortunately, the Volga-Don Canal will be closed by ice during four or five months each year. Diesel-electric ice breakers are to be used in order to shorten the ice-bound period.

The headwaters of the Volga have long been linked with streams which lead to Lakes Onega and Ladoga, and thence to Leningrad and the Baltic. This Mariinsk canal system dates from 1808, and is now to be further enlarged so that it can handle seagoing vessels with a draft of 15 feet and tonnages to 3000. This canal project ranks second in importance among current plans.

Along with the Mariinsk Canal plans, the upper Volga is to be dredged and improved where necessary. Long stretches will be transformed into a chain of navigable reservoirs by new dams.

Farther north is the Stalin-White Sea Canal, built during the early Five Year Plans, which can carry vessels of up to 1250 tons. Near the capital is the Moscow-Volga Canal, with a depth of 8½ feet. Through the latter, Moscow now has access to the White, Baltic, Caspian, Azov, and Black Seas. The city has thus achieved its goal of becoming a "port of the five seas." The combination of these waterways will enable the Union to move merchant ships and naval vessels between Arctic, Baltic, and Black Sea areas along interior lines.

The third and most ambitious canal project of the Fifth Five Year Plan is one in Middle Asia which will link the Amu Darya with the Caspian across Turkmenia. Work is now under way and completion is planned for 1957. The Caspian-Aral Canal will be 680 miles long, and irrigation will be more important than navigation. During the moister climate of Pleistocene times, the Aral Sea, terminus of the Amu Darya, filled its basin to overflowing and drained westward into the Caspian. The Caspian in turn was a fresh-water lake draining to the Black Sea. This new canal will follow the old channel. Since it crosses the Turkmenian Republic it is called the North Turkmenian Canal. This canal will divert water from the Amu Darya into the Caspian Sea in order to make up for intake losses from the diminished Volga, whose flow will be lessened by withdrawals for irrigation.

A fourth canal will extend from Stalingrad on the lower Volga eastward to the Ural River, crossing a steppe land now too dry for cultivation.

Port Development

Between 1950 and 1955, the volume of shipping over inland waterways is to increase between 75 and 85 per cent. This calls for a corresponding increase in port facilities. Thus 20 river and seaports are to double their dock and freight handling facilities, while an entirely new port will serve the Donets River.

Eight of these ports lie along the Volga and its tributaries, a concentration which reflects its importance as the center of economic gravity. Only three ports lie east of the Urals. River transport is not something reserved for remote and underdeveloped areas; it is a major facility in the key areas of industry and agriculture.

Few of the cities slated for a doubling of their port facilities are really ocean ports; those which border the Black or Baltic are largely concerned with

domestic coastal trade. A new port development at Naryan-Mar at the mouth of the Pechora will provide an Arctic outlet for coal and oil, and a sheltered naval base east of Murmansk. Shipyards are to be enlarged in eight seaports.

IRRIGATION AND DRAINAGE

The current Five Year Plan provides for new or additional irrigation water on several million acres. The total irrigated area is to be increased 30 to 35 per cent in five years. Four principal areas are involved: first, the southern Ukraine and northern Crimea; second, the Volga-Don region, both along the new canal and also extensively south of Kuibyshev; third, along the new Volga-Ural Canal north of the Caspian Sea; and, fourth, in the Turkmenian Republic along the canal from the Amu Darya.

The southern Ukraine is marginally dry, traditionally a famine land. A proposed canal will divert water from the Dnieper, and a part of the flow will be conducted across the strait to Crimea, apparently in a syphon. The irrigated area of the southern Ukraine will total 3,700,000 acres. Water from the Dnieper will also irrigate 750,000 acres of northern Crimea, plus 1,750,000 acres in eastern Crimea near Kerch.

On either side of the lower Volga lies a large rolling area of chernozem soils but inadequate rainfall. The irrigation proposals here are especially ambitious. The great dam at Kuibyshev is to be finished by 1955, and will be comparable to that at Grand Coulee on the Columbia River. Like its Washington counterpart, part of the electricity will be used to pump water into high-level canals, from which laterals will supply irrigation water to some 2,500,000 acres. Other irrigation projects near the Volga-Don Canal will bring water to 1,850,000 acres. While the Volga is a great river, it must be recognized that it drains an area where the rainfall averages but 20

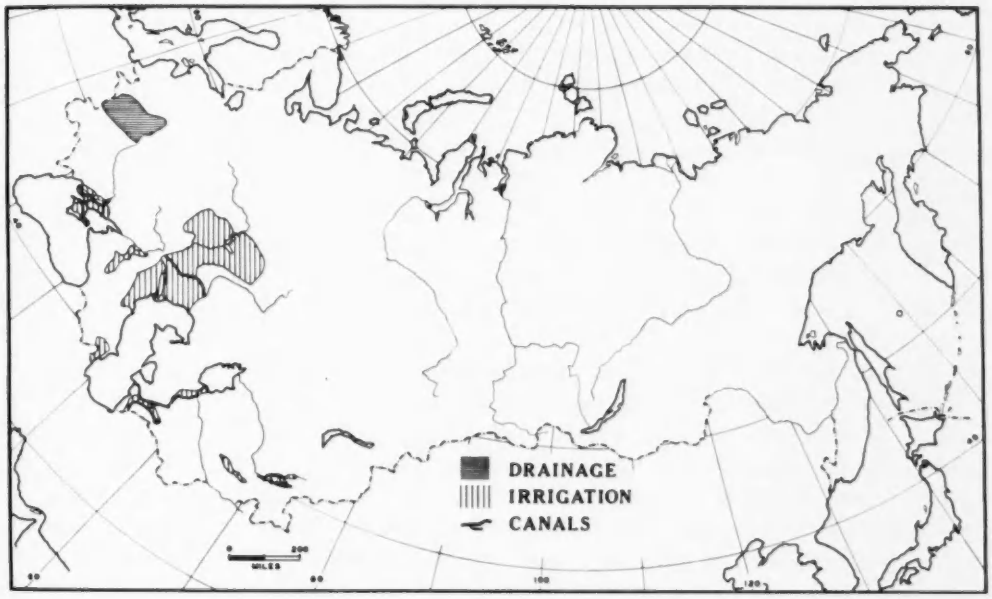

FIG. 4.

inches. Drought is recurrent, and the volume of the Volga fluctuates accordingly. In some years, little or no surplus water may be available for irrigation and trouble will follow. Where irrigation schemes involve large storage reservoirs, evaporation losses will be considerable. The total area someday to be irrigated in the Volga and Don basins reaches 10,000,000 acres, and to pump the water will require 3.5 billion kilowatt hours of electricity each year.

Little has been written about the proposed Volga-Ural Canal. It will extend eastward 365 miles from Stalingrad across semi-desert country. Problems of soil alkalinity may be expected. The Ural is nearly dry in summer, and at times no water reaches the Caspian; most of the canal water will have to come from the Volga. The area eventually to be irrigated is given as 14,500,000 acres.

The Turkmenian area is even drier, most of it proper desert. Along the line of the new canal from the Amu Darya near the Aral Sea to the Caspian, an area of 3,250,000 acres is scheduled for irrigation. The main canal will measure 680 miles, and there are to be 745 miles of branch canals. Cotton is to be the chief crop. Like the other programs, the development of this area will require a number of years.

The current Five Year Program calls for numerous additional irrigation projects, some of which will bring water to "several hundred thousand acres." One such is along the Kura River south of the Caucasus; another is in the Armenian Republic near Tiblisi; still another lies in the Kuban Steppe north of the Caucasus. The Fergana Basin in Soviet Middle Asia has recently been supplied with new canals; these are to be further developed.

In contrast to the additional water called for under these programs, surplus water is to be removed from some 8,600,000 acres of marshland in Byelorussia. The Polesian or Pripet Marshes along the Polish frontier have been gradually reduced in area over the years, and the current Plan calls for additional drainage. Other drainage projects are in Lithuania and Estonia, and in the northwest of the Russian Republic. Reclaimed land is to be increased 40 to 45 per cent.

Like all programs which alter the balance of nature, these changes are not without their dangers. When swamps are drained, good muck land may be recovered, but the lowering of the water table in adjacent areas may change the natural vegetation and alter the agricultural crops. Likewise in semi-desert areas, the addition of irrigation water may result in the concentration of deliterious soil chemicals in the surface horizon, as well as causing downslope areas to become waterlogged.

The Russians must be well aware of the huge costs and engineering problems which these water projects entail. Their economic feasibility would surely be questioned in the capitalist world. Only a pressing necessity for additional food supplies can justify the expense.

The new reservoirs on the Volga and Don have already covered almost a million acres of previously cultivated land, while those in construction and planned will flood an additional four million acres of agricultural land. Numerous cities will also have to be moved. Serious problems of silting will arise, as rivers in these dry areas carry a heavy load of sediment. Such silt must be removed before the water enters the canal systems.

Interesting secondary effects will follow, since the flow of the Volga into the Caspian, and that of the Don and Dnieper into the Black Sea will be greatly lessened. In the latter case, it

FIG. 5.

is thought that the level of the Black Sea will drop, thus reversing the currents through the Bosporus. The discharge of the Volga will decrease by a fifth through evaporation from its new reservoirs and subtraction for irrigation. This will lead to the drying up of the Caspian Sea, and the recession of the shore line. Within two decades this recession may amount to 40 miles in places. The effect on navigation and fisheries would be serious. It is to maintain the Caspian at a constant level that the Turkmenian Canal is being built.

CLIMATIC AMELIORATION

The Soviets are audacious; no engineering task is too formidable if it will increase productivity. Socialist planning admits few limitations. While there is no plan to change the winds, they do hope to modify their influence. Large areas in the southern Ukraine and along the lower Volga are a dry steppe. The more humid grasslands farther north are already under prosperous cultivation, but crop failures are frequent in the marginal areas.

During spring and summer months, hot dry winds, known as the *sukhovey* blow westward from the deserts around the Aral Sea. When these thirsty winds persist, they rob the earth of its moisture and famine results. Shelter belts are thought to be the answer.

The planting of shelter belts goes back two centuries in the Ukraine. Trees will grow in the grasslands if started under favorable auspices, but they will not reproduce themselves due to the long dry period, the low summer humidity, and the deep ground water table.

In 1948, the government announced an ambitious program of afforestation for the steppes of the Ukraine and the lower Volga to be completed by 1965. This is designed to check wind velocities, hold moisture, protect the soil, and perhaps increase rainfall. The area in which the climate is to be modified extends 1400 miles from east to west, and 800 miles northward from the Black

FIG. 6.

and Caspian Seas. State-planted shelter belts are to measure 3300 miles, and cover 291,000 acres. Collective farm plantings account for an additional 14,900,000 acres. Many ponds and reservoirs are planned to further improve water supplies. The program is well advanced, and may be nearly completed during the present Five Year Plan.

HYDROELECTRIC POWER

Ever since pre-revolutionary days when Lenin studied the electric grid of the Netherlands, electricity has been held the key to Soviet industrialization. Thus the First Five Year Plan involved the building of the Dnieper Dam, still the largest in the world outside the United States. The Fifth Five Year Plan involves a threefold increase in hydropower as compared with prewar conditions.

Currently under construction is the huge Kuibyshev Dam on the Volga, to be ready in 1955. The rated electric capacity is set at 2,100,000 kilowatts, which is equal to that at the Grand Coulee Dam. Other installations to be ready by 1955 will produce an additional 1,916,000 kilowatts.

The Volga already has three hydro plants and is scheduled for half a dozen additional dams. One at Stalingrad, to be ready by 1956, will be comparable in size to the Kuibyshev Dam, and will generate 1,700,000 kilowatts. A smaller dam at Gorki will generate 400,000 kilowatts, another on the upper Volga is rated at 330,000, the Molotov Dam on the Kama River will have a capacity of 500,000, while the Tsymlyanskaya Dam in connection with the Volga-Don Canal will produce 160,000 kilowatts; others will be on the Kama River, a tributary to the Volga. The total electric potential of the Volga basin is set at 30 billion kilowatt hours a year, and will form the world's largest hydroelectric grid. This is truly an impressive figure, if attainable. Power will be supplied to Moscow, the Urals, and to Volga industries, as well as for pumping irrigation water.

The Kuibyshev Dam is largely of earth construction, two miles in length. It will raise the level of the Volga by 86 feet and create a reservoir which will reach some 300 miles upstream. The city of Stavropol and many smaller towns must be moved to higher ground.

The Stalingrad Dam is two and a half miles long, and 162 feet high in the center. Its reservoir will cover 350,000 acres. The land to be flooded by these various dams represents good farm land, so that its loss must be charged against presumed assets.

In the southern Ukraine, a new Dnieper Dam will add 250,000 kilowatts.

Siberia is slated to have a major dam across the Ob at Novosibirsk, with a rated hydroelectric output of 500,000 kilowatts. There will be two dams on the upper part of its tributary, the Irtysh, each with a capacity of 400,000 kilowatts. Other developments are proposed for the southern Yenisei, though apparently not during the present Five Year Plan. The Union's greatest concentrated source of power is undoubtedly along the Angara where it leaves Lake Baikal. For tens of miles the river is as swift as the Niagara below the falls, and, thanks to the lake as a reservoir, the flow is constant. At least half a dozen power stations have been blueprinted along the Angara, with an aggregate output of 9,000,000 kilowatts. Several decades may elapse before the project is completed, but nearby coal and iron ore indicate that the area has major possibilities.

Electric power will be generated at two stations along the Turkmenian Canal, and at a third on the Amu Darya where the canal takes off. Still other power projects are located in the Caucasus.

It is difficult to evaluate Soviet hydroelectric capacities. This is a country of low rainfall, low gradients, and fluctuating river flow. With characteristic exuberance, the Soviet Union claims to lead the world in kilowatt potential. Certainly there are impressive possibilities, and they are receiving great emphasis at present. Since rainfall is variable, the electric output will also vary. Great dams require many years for their construction, so that all of these proposals cannot be credited to the Fifth Five Year Plan alone.

CONCLUSIONS

These projects are only a part of the total. The draft directives for Soviet economy under the Fifth Five Year Plan devote many paragraphs to industry, agriculture, transportation, and cultural well-being. Most of these projects are listed in general percentage terms; this chapter refers only to those which have specific locational descriptions and lend themselves to geographic analysis.

While the total program is ambitious, even grandiose, and there are many partial accomplishments, past experience forecasts great ability to achieve material goals. The Soviet Union clearly has growing industrial strength; this is not the first time she has challenged nature. In terms of ultimate accomplishments, however, the geographer can only point out the permanent limitations of drought, short growing season, and continentality which man can never fully overcome. Mineral reserves are vast but not always of the best.

The land of the Soviets, under whatever government, is clearly assured of a great future, but that future can never be strictly first class. Premier Stalin gave his country the task "to overtake and surpass the capitalist world." From the standpoint of geography this does not appear possible.

SETTLEMENT CONTROL BEATS FLOOD CONTROL*

Walter M. Kollmorgen

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IN the Kansas River Basin, as well as in many other river basins, there is an urgent need for alternative plans dealing with flood problems. Such plans should be submitted to the public for acceptance or rejection, and they should be submitted with revealing price tags. Under present procedure, the public is confronted with a one-or-nothing program and the proposed program is likely to be extravagant in financial cost as well as in land cost, *i.e.*, land destroyed by permanent flooding. Geographers and other technicians could be very helpful to engineers with a dam-building complex by exploring alternative arrangements to reduce flood losses and translating these various arrangements into plans for public consideration.

Floodplain Cannibalism

Present programs for bringing some measure of flood protection to the Kansas River Basin—and also certain other basins—by the construction of a multiplicity of dams represent an interesting form of floodplain cannibalism. This cannibalism results in part from the common misconception that flood control means control of floods. Since no scheme yet devised will control floods in the Midwest, the tantalizing mirage of "flood control" must lead to a multiplication of dam structures until major portions of our prized alluvial valleys lie buried under a stair-step series of lakes.

Equally interesting is the fact that irreplaceable farm land is being cannibalized by replaceable sites for urban developments. During the 1951 flood, according to the Corps of Engineers, about 90 per cent ($479,000,000) of the damages experienced along the main stem of the Kansas River occurred in urban areas. It is this large urban loss which is now cited to justify the greatly expanded dam-building program in the Kansas River Basin. To bring a greater measure of protection to these urban areas it is proposed to flood permanently from 150,000 to 200,000 acres of the best agricultural lands in eastern Kansas or in lowlands adjacent to the Kansas River. Flooding these large tracts of lowlands will also blight the economy of many miles of adjacent uplands which are or should be in grass. These lowlands supply large amounts of concentrated feeds to supplement the forage of the uplands. It follows that the present plan of controlling floods is nothing less than a Rube Goldberg dream and one with a frightful price tag.

Let us try to gauge the nature of the appetite of the carnivore many propose to liberate in our floodplains. In 1944 the Pick Plan recommended an expenditure of somewhat less than one billion dollars to bring a reasonable measure of flood protection to the entire Missouri Basin (House Document No. 475). Since then and particularly since 1951 the flood control plans for the Kansas River Basin alone have been so extended and elaborated that

*Presented before the Association of American Geographers at Cleveland, March 31, 1953.

they bear a price tag of nearly one billion dollars. And note that the Kansas River Basin covers about one-tenth of the Missouri River Basin. In 1944 the cost of flood control works in the entire Kansas River Basin was estimated at $82,000,000. This last sum will now be inadequate to cover the cost of the Tuttle Creek project alone. In other words, in less than 10 years, cost figures have increased ten-fold in only one basin tributary to the Missouri. Part of this represents inflation but most of it represents a multiplication of dam structures. We would be sanguine to believe that a similar growth and elaboration of costs and plans will not spread over the entire Missouri River Basin and also the rest of this nation if present plans of flood control become standard procedure.

More shattering than the rising costs are the rising figures of acres of land that are to be flooded by more and more dams. Once more we refer to the original Pick Plan (1944) which recommended eight dams for the Kansas River Basin, six of them for the Republican River Basin. By 1950, a more comprehensive report appeared on the Kansas River Basin (House Document 642) in which 18 reservoirs were recommended for flood protection. Then came the super flood of 1951 which has triggered a shotgun blast of proposed dams peppered throughout the Kansas Basin, but with a great concentration of concrete structures near the main stem of the Kansas River. At the present time the Corps of Engineers lists about 34 basic reservoirs for the Kansas Basin and 84 more sites are being studied for additional dam structures. Note the increase in possible dams—eight to 118! To build even a majority of these will cost about $1,000 per acre of protected or partly protected land. Since this land costs from $300 to $500 per acre, it would be cheaper to buy it and set it aside than to try to protect it.

Another facet of the present flood control program is significant. The publication referred to in the preceding paragraph states in part (p. 33): "There are 150,000 acres of land adjacent to the main stem of the Kansas River and 35,000 acres along minor tributaries subject to flood damages." The revised and enlarged flood control plan for this main stem alone calls for the erection of about three dozen dams in the eastern part of this watershed. These will inundate from 150,000 to 200,000 acres of the best farm land in the state—depending in part on whether Tuttle Creek is operated as a dry dam or a wet dam. Roughly this suggests the permanent destruction of about one acre of good farm land above a dam to protect one acre of farm land below the dam. This deliberate and expensive flooding of land can be compared to a 1951 flood coming every second year. The only difference is that we would pay for the destruction of a permanent asset. But most floods are lesser floods and cover from several thousand to several tens of thousands of acres of floodplain. It follows that during the lives of one or several generations of farmers we will have extinguished from two to four acres of land to partially protect one acre of land. Moreover, we are doing this at a time when we are paying from $500 to $1,000 per acre to bring irrigation to many farms in the arid west.

Nor is the extravagant flooding of rich floodplain land in eastern Kansas unique. An equally shattering program has been worked out for the Grand River of northern Missouri. Here it is proposed to inundate 151,000 acres to protect 212,000 acres below them. To achieve this, five towns need to be

relocated and hundreds of farms will be obliterated or shattered in their upland-lowland composition. Nature, with all her whims and vagaries, would have to provide major floods with total destruction in two years out of five to match the destruction for which we will pay at least one-half billion dollars. In northern Missouri, as in eastern Kansas, upland soils are poor and erosive. In Missouri, as in Kansas, the proposed program will drive more farmers into the hills which are already overloaded with small farmers cultivating marginal land which should be in grass. Continued and increased intensive farming in the uplands will call for greatly increased expenditures for conservation measures, a cost which has been ignored in computing the benefits of the dam-building program.

Paradoxical as it may appear, present flood-control engineering works not only enhance the danger of floods, but actually contribute to the high flood losses which in turn are used to justify more extensive and complicated control structures. Consider the location of the dikes along the Missouri River at Omaha, St. Joseph, and Kansas City. Although the floodplain in these places is from one to many miles wide, dikes to contain rising waters are established on the banks of the river. The result was that the flood early in 1952 almost breached the dikes at Omaha, and by only a very narrow margin was a major disaster in that area averted. At St. Joseph major dikes were destroyed, with a great multiplication of property damage. Fortunately, dissipation of flood waters over a wide floodplain above Kansas City limited the flow at that city so that the waters negotiated the bottleneck in that city. Every bottleneck also deepened and widened flood waters upstream, with further multiplication of flood losses. Set-back dikes at Omaha, St. Joseph, and Kansas City would readily have accommodated the flood surge with less actual and prospective destruction of urban and industrial developments as well as improvements above the strictures.

The major flood in the Kansas River Basin in 1951 likewise was greatly increased in destructiveness by so-called flood protection works. Major dikes have been built on the very border of the stream in the Topeka and Kansas City areas, although the floodplain is from one to two miles wide in these places. The effort to save every last foot of this property for urban and industrial developments was self-defeating and resulted in hundreds of millions of dollars worth of damage. Set-back dikes, allowing the river several stream widths between dikes, would accommodate major floods. Although this lesson is obvious to all who study the present dike structures, the solution still advanced by the Army Engineers is to flood hundreds of thousands of acres of the finest agricultural lands in the Midwest for which their main justification rests on the protection of urban developments which could readily be moved in part to high and flood-free ground.

Present plans of so-called flood control in the northern Kansas and Missouri area contravene both the spirit and the achievements of resource conservation. The spirit of conservation calls for husbanding of our resources, and the practice of soil conservation calls for a sustained land-use program.

The significance of floodplain land in northern Kansas and northern Missouri cannot be overemphasized. In much of this area glacial till is either absent or of very limited depth. Moreover, the deep and valuable loess of Nebraska and Iowa is here very limited

in extent, with the result that much of the hill land and slope land has a thin veneer of soil. The Flint Hills of Kansas extending north-south of Topeka and Manhattan are an extreme example of this kind of land. Here lie thousands of acres of land with only a few inches of soil and soil material on a very shallow bedrock. Much of the remaining land has a hardpan within a foot of the surface and bedrock at a depth of two to three feet. This land already presents a serious problem in management because of the tendency to overplow and overgraze. Flooding a third of the floodplain lying in this area will create an almost insoluble problem in soil conservation. Many hundreds of upland grazing units within the area will lose a dependable supply of concentrated feeds. In combination, these changes mean more overgrazing, more overplowing, more small, uneconomic farming units, and, most of all, more devastating erosion. These geographic changes seem to be completely ignored by the Army Engineers and also big city pressure groups, who seem to be totally ignorant of where their food comes from and what gives them employment. It is urgent and even imperative that in the problem we face, structural engineering become the handmaiden of geographic engineering if we are to go forward rather than backward in a resource conservation effort. The tragedy of the Pick-Sloan Plan is that it destroys more wealth than it creates, and it achieves this by squandering several billions of dollars of public money.

COST-BENEFIT CLARIFICATION AND RECTIFICATION

It is submitted that geographers and other technicians can make a basic contribution to all water-control and water-management programs by scrutinizing and rectifying a weird structure of fairyland economics generally referred to as cost-benefits ratios. This structure has become particularly complicated with the advent of the multiple benefits concept. By magnifying one or several real or imagined benefits, almost any kind of engineering monuments can now be justified. This is particularly true of non-reimbursable benefits because beneficiaries make no special payments for projects developed and so no account can go into the red. If beneficiaries would be required to reimburse the federal Treasury for many or most of the benefits listed on water-control programs, the entire program would shrink to size and sense overnight.

From the standpoint of landforms and soils, floods have a constructive as well as a destructive side. This should be, but is not, reflected in flood-loss estimates. Consider, for example, the major and unusual flood in the Kansas River Basin in 1951. Some alluvium deposits improved terrain and drainage; other deposits made for an improved soil structure after shallow or deep plowing. Still other deposits of proper texture will prove of value in that they increase the inventory of certain plant foods. Let us briefly consider some of these constructive processes.

Prior to the flood, some floodplain farmland was uneven in elevation, possibly with pockets of water, wet spots or seepage spots. Drainage problems may have made for some waste land or land marginal for farming. The fill or deposits left by the flood obliterated some of the uneven terrain and greatly improved the drainage. Examples of this are not difficult to find. A friend of mine remarked that before the flood he valued his land at $300 per acre, but after the flood he

valued it at $400 per acre because fill of proper textured material had solved all drainage problems and removed all waste land. Here is an example of where an inventory of flood losses should also include an inventory of flood gain.

Another flood gain that was not uncommon was the deposit of sandy material of limited depth over fine-textured gumbo land. Gumbo land presents problems in management, drainage, and crop production. Several inches of sand deposits can readily be plowed into a gumbo soil, and in combination this mixture greatly improves the working qualities and productivity of the soil. Even deposits of sandy material from 12 to about 24 inches deep were mixed with formerly exposed soil material by deep plowing, that is, plowing three to four feet deep. Plowing at a depth of about three feet cost about $30 per acre. This expense was associated with the flood loss and was therefore largely paid for by the government. Now it develops that these deep-plowed fields yielded about 20 bushels more corn per acre than the shallow-plowed fields which had little or no fill or deposits. The result is that plans are now underway to deep-plow other fields with little or no deposits to rejuvenate them or to increase their productivity. In other words, increased yields from many deep-plowed fields in one year paid for this special operation and there are those who believe that deep plowing may become a standard practice in the floodplain to increase soil productivity. Here is another benefit that was not listed to partly offset the flood losses.

It is not necessary here to dwell on the value of new alluvium of proper texture. For several thousands of years these new deposits made a garden spot of the Nile Valley. Now that dams are regulating more and more the flow of that stream and the silt remains behind the dams, Egypt is rapidly approaching productivity and fertilizer problems. Cotton also yields a shorter staple and a more brittle fiber. Closer to home we have the example of the Missouri River floodplain between St. Joseph, Mo., and Sioux City, Iowa. In 1952 farmers in that floodplain boasted some of the best corn and soybean yields they ever experienced—early in the year their lands were flooded and new alluvium was deposited. The flood losses were given wide publicity; the high yields that followed have hardly been noted. Here again, only the losses are stressed and magnified, partly to justify big engineering works.

That too much stress has been given to land destruction is well indicated in news releases by agricultural specialists at Kansas State College, Manhattan. Under the date of Sept. 11, 1951, Manhattan, Kansas, comes this news item:

FLOOD A SOIL AID

K-State Scientist Says Most of the Kaw Valley Will Produce Better as a Result

Can Build Up the Sand

Only Loamy Earth Is Damaged by Deposits—Some Drainage Problems Erased

—A Kansas State College soil scientist says a large part of the land flooded by the Kansas river in July will produce better crops in the future because of the flood.

Describing the popular conception of soil damage as "grossly exaggerated," Harry C. Atkinson, associate professor of soils, said the sandy soil many persons think is ruined will be the best sweet potato and watermelon land in the valley within a short time.

Atkinson and W. A. Badgley, USDA soil scientist, have been surveying the north side of the Kansas river from Wamego to Lawrence since April. They have run a spot survey of the north valley from Wamego to Lawrence, but will not complete their detailed survey until 1952.

Atkinson said it is too early to give figures, but he estimated that only 10 to 20 per cent

of the severely flooded land on which all crops were lost has been damaged by the flood.

The other 80 to 90 per cent, he said, eventually will yield better crops.

Pictures the college has of sand deposits after the 1903 flood show they now are part of land that is selling for $400 to $600 an acre, Atkinson said.

Once the sandy soil is built up with organic material it will produce alfalfa, sweet potatoes, corn and other crops—the same as the 1903 sandbars have been doing consistently, he said.

Sand deposits on loam soil are detrimental, he continued, but sand on sand makes no change in the ability of the soil to produce. Sand on clay is beneficial so far as workability of the land is concerned.

"We've heard nothing but bad news from the flood," he said. "Besides enriching a large part of the river valley land, it filled in some low spots that were formerly drainage problems. Now they will drain off."

Where raging water scoured and cut away top soil, it definitely lowered the productivity and the value of the soil, he said, but those washed away spots are not completely sterile and will produce lighter crops.

Atkinson's survey shows much of the flooded land is richer with elements needed for crop production than it was before the flood. There is little or no need for fertilizers except on land with heavy sand deposits, he said, and they need nitrogen added.[1]

The foregoing estimate, it should be noted, comes from a soil scientist who was in the process of studying the flooded lands.

Present methods of figuring cost benefits also do not make allowances for the disturbed hydrological conditions which follow the impounding of large bodies of water in floodplains. Suppose a dam about 100 feet high is thrown across a floodplain and impounds a lake with a depth somewhat less than 100 feet. Ground-water conditions will be disturbed for many miles above the upper part of the lake and deterioration of land will follow. Moreover, the stream debouching into the lake will have its gradient disturbed, will drop part of its sediment before it reaches the lake, and will experience a rapid process of aggradation. Before long it will meander frequently and widely over the floodplain, leaving stranded bridges, causing road problems of many kinds, and also bringing many losses to farmers. A realistic method of cost-benefits computation would have to provide for much land deterioration and loss above impounded lakes, particularly in wide floodplains with gradual slopes.

Many other peculiar cost-benefit manipulations serve to justify a clutter of dams in the wide floodplains of the Midwest. Multiple benefits are usually mixed into this fruitcake which is then wrapped as a gift package. Although flood mitigation may be the main purpose in building a dam, other benefits may be assigned to irrigation, power development, and river navigation. However, these multiple benefits usually create a conflict in purpose. For example, for irrigation, navigation, and hydro-electric power, water needs to be stored in large quantity, but for flood control reservoirs should be empty when a flood season threatens. To serve these partly conflicting purposes, a great reservoir is built, at tremendous cost in money and irreplaceable land, which can be kept partly filled and partly empty.

Particularly the benefits assigned to navigation have no basis in fact or in promise. Expenditures on the Missouri River to bring water navigation to Sioux City are rapidly reaching the half-billion dollar mark. This program was inaugurated in the 30's in terms of a 6-foot channel and this was largely achieved by the early 40's. The traffic at that time, however, needed to be nearly 1000 per cent greater than it was to justify the development costs. Subsequently a 9-foot channel became the objective, and this has largely been achieved. Even with this channel depth, the recent traffic on the river is but an insignificant proportion of the tonnage projected to justify development costs. It is still correct to say

[1] *Kansas City Times*, Sept. 12, 1951.

that the real cargo hauled on the river needs to be increased by over 1000 per cent to justify the money thrown into the muddy Missouri to make it navigable. Compounding this nonsense, the government has even placed its own barges on the river and thereby increased the waste of the taxpayer's money, for during most years these barges have lost money for the government although they are not required to pay one cent for the use of this expensive waterway. To flood even one acre of good farm land to achieve this sort of waterway is a social, economic, and political iniquity.

GEOGRAPHIC ENGINEERING WILL MITIGATE FLOOD LOSSES

In the lower Kansas River Basin as much as one-half of the best floodplain may be destroyed by present and proposed dams. Justification for the destruction of so much good land is based on flood losses, particularly losses which occurred in 1951. These losses, however, are largely the result of unwise encroachment on the floodplain, particularly city developments. Losses of personal property and permanent improvements were far greater than land and crop losses. Proper geographic engineering with a limited amount of structural engineering could have reduced the latter losses to a small per cent of the actual losses, and these limited losses in turn would not have justified the expensive clutter of dams now proposed.

Farmers farm floodplains by necessity but urban and industrial developments in the Missouri Basin encroach on floodplains by choice and not by necessity. No basic resource is lost by zoning enough floodplain land against improvements to allow a stream several stream widths between dikes in urban and industrial areas. If such a program of set-back dikes had been developed in urban areas prior to recent floods, there would have been no big urban losses, basin-wide losses would have been much smaller, and no justification in terms of cost-benefits would have sanctioned the extravagant program of development now underway. Under present plans we will flood many hundreds of acres of the finest agricultural land in the state to protect one acre of urban floodplain land which has only limited site value for improvements that could readily be shifted to secure upland locations.

Farm losses could also be greatly reduced by geographic engineering. Again we refer to the floodplain of the Kansas River for an example. This floodplain has an average width of somewhat more than two miles. At least up to the great flood of 1951, farmers always considered it their privilege to build farmsteads within a stone's throw of the stream. It was this indiscriminate location of farmsteads on the floodplain that contributed to heavy farm losses. Yet, within sight of all these farmsteads, and usually within a distance of less than one mile, there are extensive high and dry uplands ample to accommodate all these misplaced farmsteads. Many of these farmers already negotiate distances of one or several miles to scattered tracts of farmland. Geographic engineering could serve to zone all the flood-threatened areas against farmsteads, and government aid could be extended to relocate improvements now in danger areas. In combination with this program, flood danger could be mitigated by building small wet and dry dams in V-shaped tributary valleys rather than on floodplains several miles wide. Instead of considering this arrangement, which would cost but a fraction of the present big dam program,

we are in the process of extinguishing up to 50 per cent of our floodplain in eastern Kansas, which, among other things, will drive more farmers onto the thin erosive soils of the hills.

Summarizing the above observations gives these interesting results:

1. Urban and industrial losses would be largely obviated by set-back levees and zoning and thus cancel the biggest share of the assessed benefits which now justify big dams.
2. Farm improvements in valleys several miles or less in width would be zoned to flood-free elevations and therefore cancel the second highest assessed benefits which now largely justify the big dams.
3. Crop losses on wide floodplains would be mitigated by damming narrow tributary valleys—largely V-shaped valleys—but occasional losses would be accepted on this usually highly productive land.
4. Land and soil destruction by flooding is largely a myth and therefore does not justify flooding out one set of farmers behind dams to save another set of farmers below the dams.
5. Water navigation on the Missouri as a cheap mode of transportation is a total myth and justifies no expenditures whatsoever.

In combination, the above observations and facts suggest very clearly that flood-control planning and execution is not a task that should be entrusted alone to military technicians. Flooded floodplains are in no way to be compared to an enemy, although our attack on flood problems suggests the lavish expenditures of money and resources thrown into a military campaign. Geographic engineering directed at settlement control can resolve many of the flood-loss problems. Only a secondary role in this effort should be assigned to structural engineers to impound waters in narrow V-shaped valleys and to erect set-back dikes in metropolitan areas. In this way our collective wealth and welfare will be enhanced and not lie buried under vast inland lakes.

ECONOMIC REGIONS OF CHOTA NAGPUR, BIHAR, INDIA

Pradyumna P. Karan

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THE name Chota Nagpur Plateau is applied to the region of plateaus, hills and intermontane valleys which occupy the southern half of the state of Bihar in India. It is the easternmost continuation of the plateau of Peninsular India. This southern upland region of Bihar extends as far eastward as the Rajmahal Hills overlooking the narrow plain on the right bank of the Ganga. Towards the north the plateau region descends gradually to the Middle Ganga Plain. The region comprises the administrative districts of Ranchi, Palamau, Hazaribagh, Manbhum, Singhbhum, Santal Parganas and small parts of Shahabad, Gaya, Monghyr, and Bhagalpur Districts of Bihar (Fig. 1).

Introduction

Within the framework of Chota Nagpur Plateau there are regional differences in the natural resources, activities of man, and economic conditions. Relief, altitude, vegetation, and geological structure together with resources and economic development (rural or industrial, i.e., mining and manufacturing) distinguish one geographical region from the other. The system of economic regions studied in this paper not only takes the industrial and agricultural development as its basis but also includes the whole set of economic potentialities and activities of each region, thus giving it its own personality.

Relief plays a great part in characterizing the major divisions of Chota Nagpur Plateau (Fig. 2). Thus clear-cut divisions like the Ranchi Plateau, Hazaribagh Plateau, Western Higher Plateau, Son Valley, and Damodar Valley are reflected in the relief map. Topography is one of the important bases of the regional divisions.

Geological considerations give precise boundaries to certain mining regions (Fig. 3). For example, the Damodar and its tributaries comprise a catchment area of nearly 6960 square miles in Chota Nagpur, but the Damodar Valley economic region (No. 1)[1] coincides instead with the outcrop of the coal-bearing Gondwana rocks. An outcrop of the Gondwana rocks to the north forms the important Giridih coal mine area (No. 7) which constitutes another region. Similarly, the outcrop of coal-bearing Gondwana rocks in Palamau District comprises the coal fields of the Daltonganj, Auranga, and Hutar which have been grouped to form the Daltonganj economic region (No. 8). Thus geology forms an important basis of the regional divisions, the extent and alignment of the mining regions often corresponding closely with major formations.

[1] Numbers refer to regions described in the text and marked on Figure 4.

FIG. 1. Chota Nagpur, showing the administrative districts. Dotted lines indicate district boundaries. Thick line delimits Chota Nagpur Plateau from the middle Ganga Valley to the north.

The mica region (No. 2) appears to coincide approximately with the Dharwar outcrop, the schistose and gneissic rocks with which mica is associated, in the northern part of Chota Nagpur Plateau. These descend by a series of scarps to the Ganga Valley.

The Singhbhum copper mining area (No. 3) is restricted to the northeastern and eastern side of the Dhanjori Range which contains the copper bearing Archean (Dharwar) rocks, although the geological copper belt extends in the west up to Kharsawan. The main copper region would thus comprise an elongated area from Rakha to Mushabani, in which important mines are at present located. The future development of the geological copper belt may extend this region.

The Kolhan iron ore region (No. 4) corresponds roughly with the outcrop of Archean rocks—Iron Ore series. Although iron ore is found throughout the region, the chief mining area at present is in southern Kolhan in the Iron Ore range around Noamundi and Gua (Fig. 14), and the other parts of the region are devoted mainly to forest industries (timber cutting and lac rais-

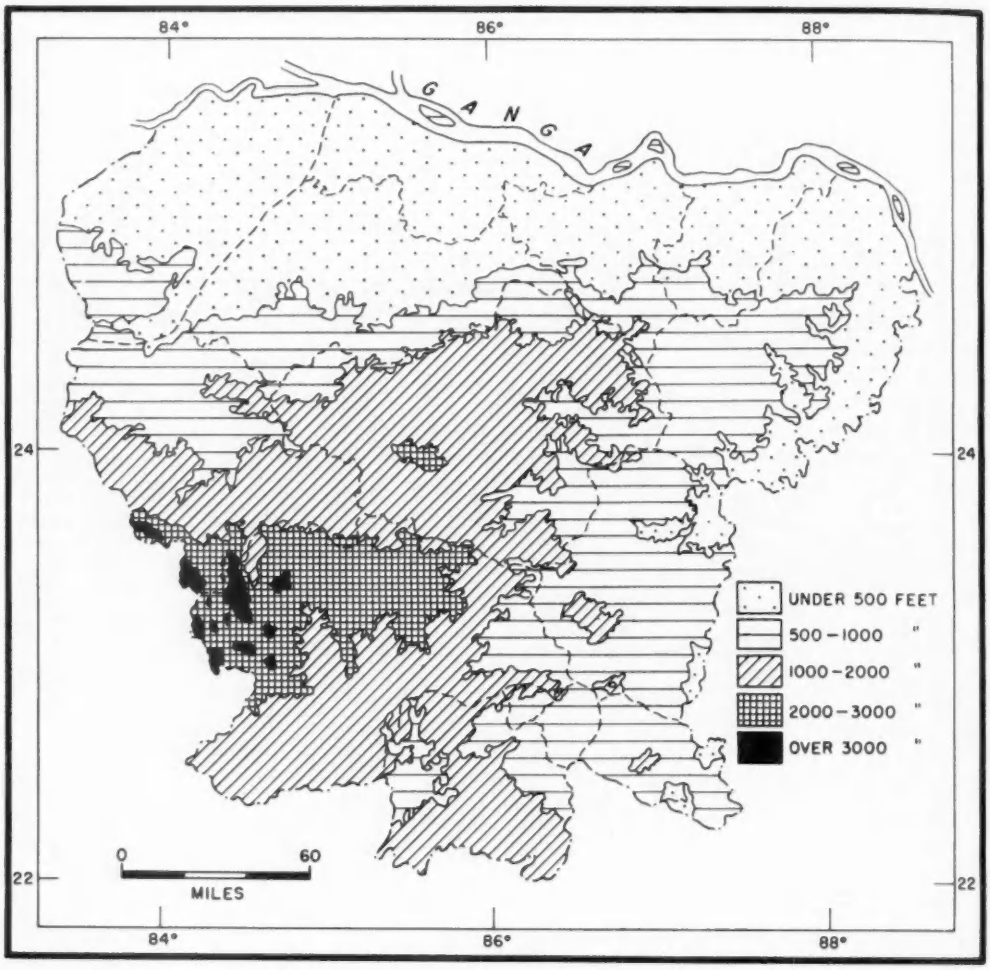


FIG. 2. Relief. Orographical regions like the Ranchi and Hazaribagh Plateaus, Western Higher Plateau, etc., are reflected.

ing) and to a very limited extent to agriculture.

Thus in the district of Singhbhum, which is mainly a zone of heavy metal industries, we have (a) the copper region (No. 3) in the east, both a mining and smelting area; (b) the Kolhan iron ore mining area (No. 4) from which iron ore is sent to Tatanagar steel works; and (c) an iron and steel and heavy metallurgical industrial region around Tatanagar (No. 5), a small area which utilizes the iron ores from the Kolhan region and coal from the Damodar Valley and depends upon rail transport. The region around Tatanagar presents a different landscape as it is a heavy industrial area. Besides these three industrial economic developments in Singhbhum, rural economic development is found in the Kharkai—Subarnrekha Plain (No. 18) mainly in Saraikella and in a narrow strip along the Subarnrekha River.

The Jhalda lac and shellac region (No. 19) is both a lac producing and a shellac manufacturing region. This economic region coincides with the hilly and forested part of western Manbhum and the adjoining areas of Ranchi and

Hazaribagh Districts. To the east, this region fades away into the plain of the Kasai and its tributaries which constitutes the agro-economic region of eastern Manbhum (No. 16). The Eastern Manbhum region and Jhalda region differ from the Baghmundi and Dalma hilly areas (No. 17) to the south where the economic activity is the cutting of forests, except in a few favored areas where crops are cultivated; it is therefore convenient to have the latter area as a separate economic region.

Physical conditions, as already pointed out, form an important basis for the delimitation of all the economic regions. In the case of the agro-economic regions physical factors are all the more important. On account of the transitional character of the climate of Chota Nagpur Plateau the crops grown are a curious mixture of those cultivated in the drier regions towards the west and those found in the wetter region of West Bengal. Rice is the dominant crop in the valleys and

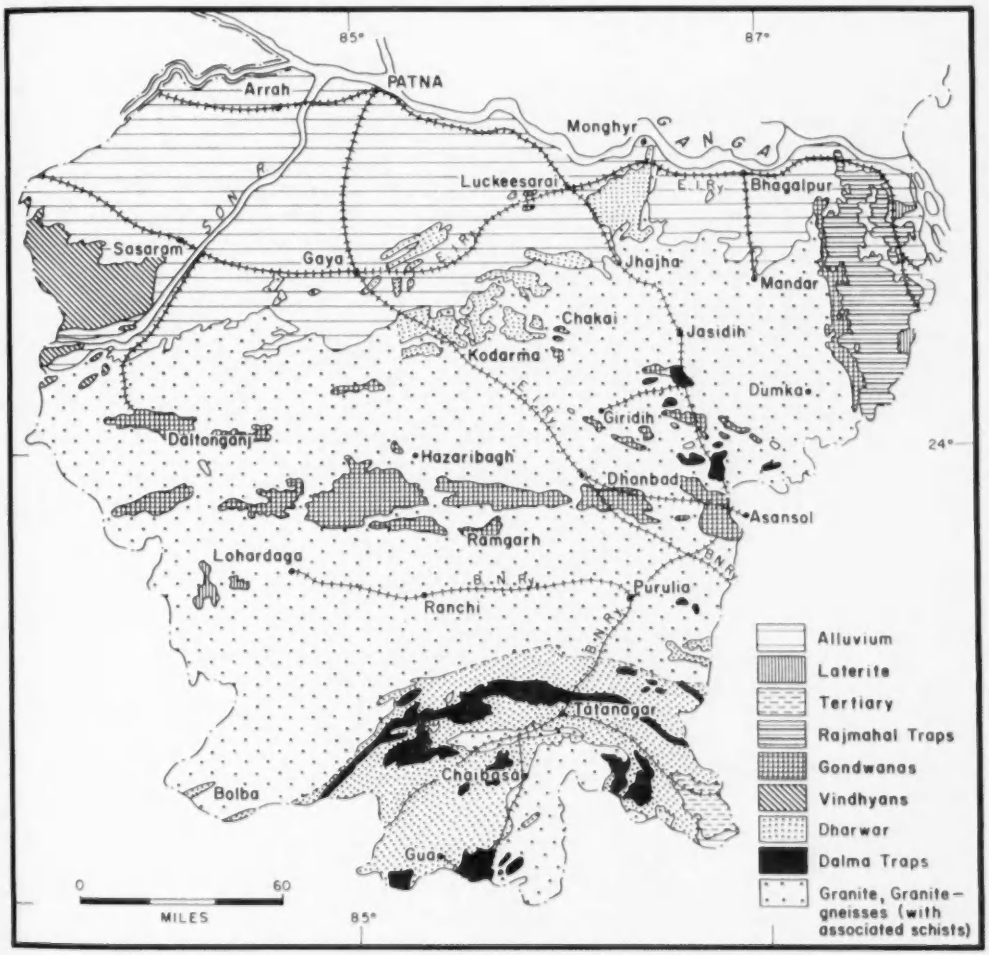


FIG. 3. Geological formations. Associated minerals are iron ore, manganese, and copper with the Dharwar (Archean) formations of Singhbhum District; mica and rare earth minerals with the Dharwar rocks of northern Chota Nagpur; building materials with the Vindhyan formation of the Son Valley; coal with the Gondwana formation; and bauxite with the laterites. The extent and alignment of certain mining regions compare very closely with the outcrop of major formations.

on the terraced slopes, and maize, millets, and oilseeds on the uplands (Fig. 20). Further, there is diversity as regards the character and intensity of cropping itself in different regions. These differences are directly related to the relief, soil, and climatic conditions found in particular regions, and reveal the subtle way in which apparently small differences in physical conditions have caused variation in agricultural response.

It is, however, needless to point out that there is no hard and fast line which may be said to delimit a particular economic region, for the change from one region to another is often gradual and even imperceptible. There must in every case be certain debatable ground which may be included either

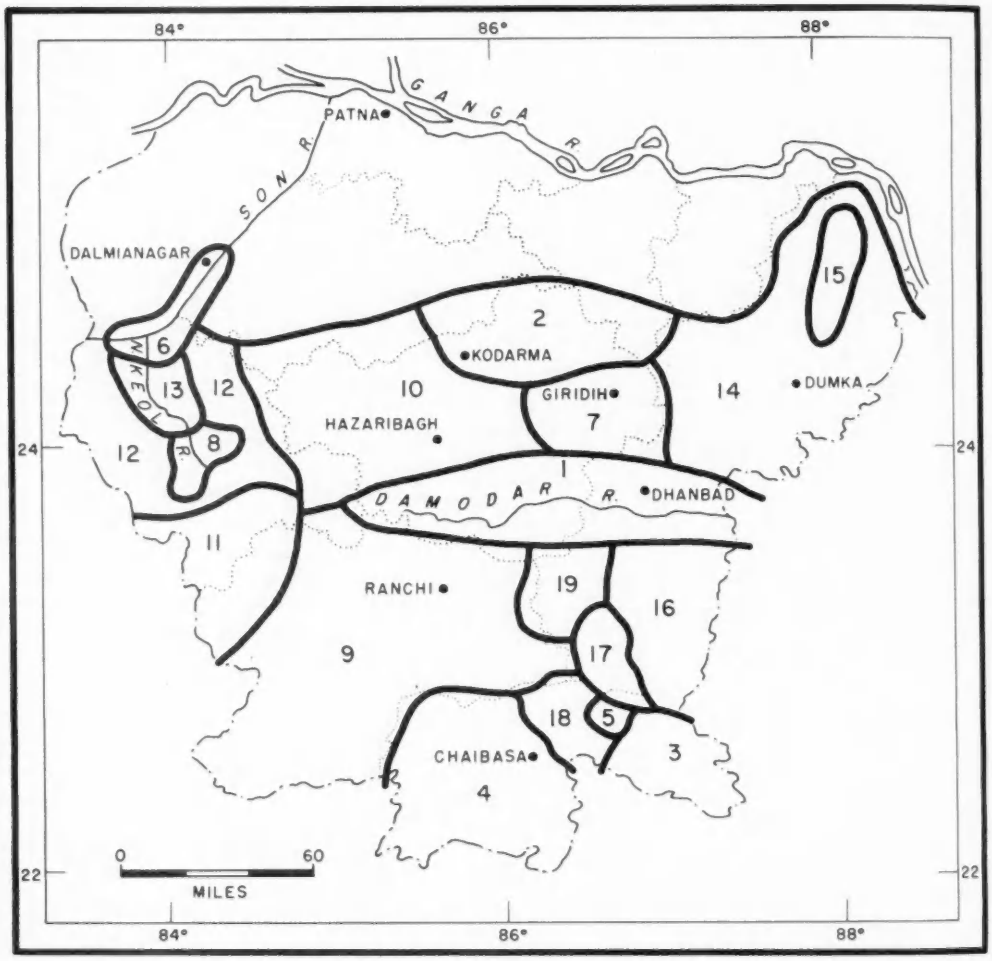


FIG. 4. Economic regions of Chota Nagpur. Numbers same as in the text. Thick lines mark the regional boundaries and dotted lines indicate district boundaries. Scale of map is same as that of relief, railway, and road maps to make comparison easy.

Industrial economic regions: 1. Damodar Valley; 2. Mica region; 3. Singhbhum copper region; 4. Kolhan iron ore region; 5. Iron and steel and heavy industrial region around Tatanagar (Jamshedpur); 6. Son Valley; 7. Giridih coal and mica industrial region; 8. Daltanganj coal region.

Agro-economic regions: 9. Ranchi Plateau; 10. Hazaribagh Plateau; 11. Western Higher Plateau; 12. Palamau hilly region; 13. North Koel Basin; 14. Santhal Parganas Highlands; 15. Rajmahal hills region; 16. Eastern Manbhum region; 17. Baghmundi and Dalma Range; 18. Kharkai-Subarnarekha Plain region; 19. Jhalda lac and shellac region.

in one region or another. It may be observed, nevertheless, that each agricultural or industrial region into which Chota Nagpur has been divided is fairly clearly defined by distinctive features of its economic geography and is unified by other well marked geographical features which give the region its distinctive quality and mark it out from the rest.

Chota Nagpur is classified, therefore, on the basis of the physical conditions, resources, economic development, and human activities as already mentioned, into nineteen economic regions (Fig. 4), eight having industrial (i.e., mining and manufacturing) economic developments and eleven having agro-economic developments. Each of these regions has homogeneity from the point of view of economic geography.

ECONOMIC GEOGRAPHY

An account of the economic geography of each region is now given. The economic development of the regions has been largely the result of the extension of transport facilities to the different areas. The role of transport, therefore, has been brought out in the development of each unit.

1. *The Damodar Valley (coal mining) economic region*

The Damodar Valley forms a distinct economic region, having its own economic personality to which all the activities are related. The human activities in this region are in one form or another concerned with the coal industry and various other industries utilizing coal and its by-products. The whole set of economic activities which the coal has been able to produce is dependent upon the intricate system of efficient and quick railway transport.

It would be out of place here to deal with such a vast subject as the mode of formation of coal. It will suffice if the manner in which it is known to occur is briefly outlined, because it is of economic significance.

Due to crustal movements of an earlier date (pre-Gondwana) the plateau region of Chota Nagpur was broken up by a series of faults which almost divided it into separate northern and southern parts. Large blocks of rock sank down between these faults. Lakes were formed in these rift valleys in which the waste of the adjoining highlands was deposited. Along with these sediments were deposited large quantities of plant debris from the dense forests and swamps of the time. These gave rise to the rich beds of coal of which Bihar is so proud. The deposition of the sediment together with the coal-forming material caused further subsidence which has tended to preserve the Gondwana rocks from removal by surface denudation. A fact of great economic importance is that the horizontal coal-bearing Gondwana deposits have not been subjected to crushing or folding which would have lessened the commercial value of the coal by making its extraction difficult and costly. The principal basins of Gondwana rocks are distributed in an east-west belt, parallel to the structural trend of the Archeans, and conforming approximately to the direction of the Auranga and Damodar Valleys, from the Hutar coal field in the west to the Jharia and Raniganj coal fields in the east (Figs. 3 and 14). There are, however, other basins of Gondwana off this main line of strike, some of which, such as Giridih, contain important coal fields. The Damodar Valley coal occurs in the Damuda series of the Lower Gondwana rocks, whose Barakar and Raniganj stages carry thick seams of coal, interbedded with sandstones and shales. Generally, sandstone is found to overlie coal with a layer of

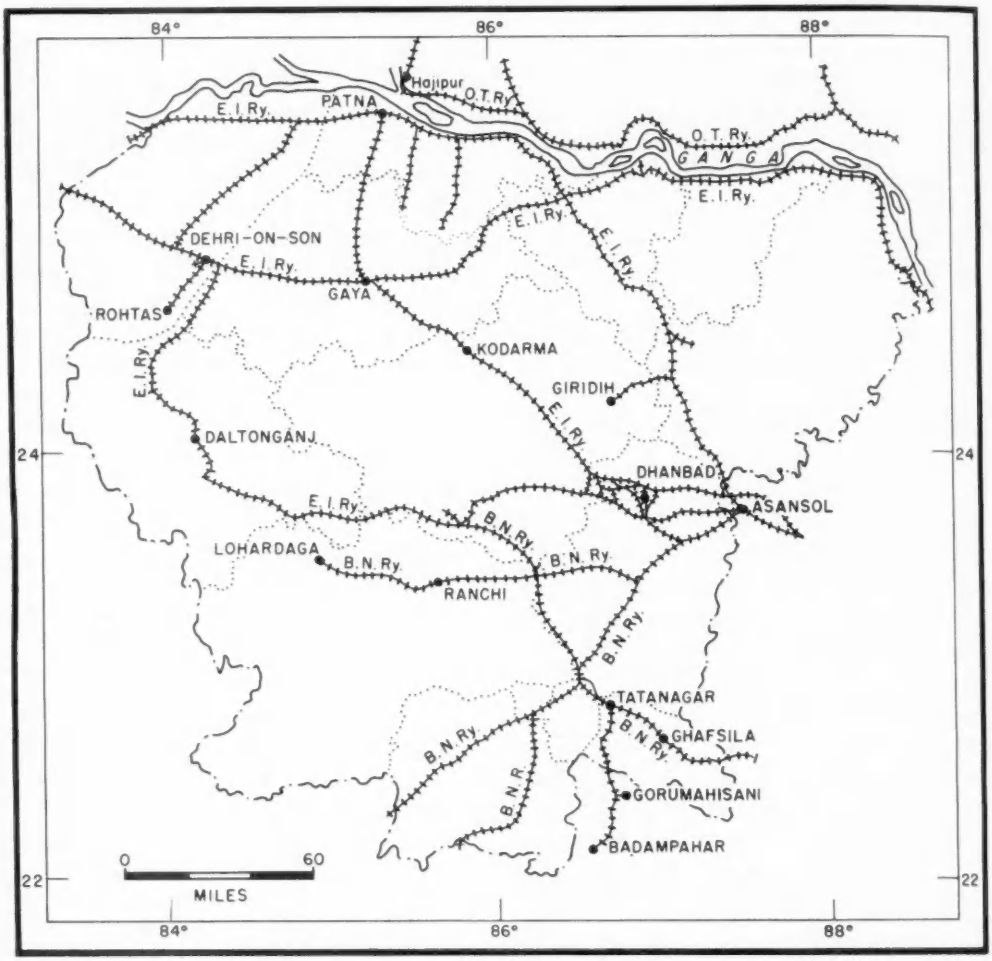


FIG. 5. Railways. Relatively thick network of railways is seen in the industrial areas of Damodar Valley and the southeast.

pebbles immediately above the latter, while shale underlies it. The coal basins are bounded by major faults. In the Barakar stage in the Jharia coal field there are 18 workable seams totalling nearly 200 feet of coal. In the Raniganj stage of Raniganj coal field, there are six important seams, but only the western end west of the Barakar River lies in Bihar and better quality seams are largely located outside in West Bengal. In general the coal is laminated bituminous, in which dull and bright layers alternate. Many of the coal fields of the Damodar Valley have been invaded by dikes and sills of mica-peridotite. They have been responsible for converting many million tons of good quality coal into *jhama* (partially coked coal).

Within the Damodar Valley region (in Bihar) there are several coal fields, of which the Jharia, Bokaro, Ramgarh, and Karanpura may be described as premier producers.

The Jharia coal field lies mainly north of the Damodar River, between longitudes 86° 06′ and 86° 30′, covering an area of 175 square miles. According to C. S. Fox the total reserves of coal

in the Jharia field are 1707 million tons at a depth of 500 feet, 3122 million tons at a depth of 1000 feet, and 4237 million tons at a depth of 2000 feet. At the western end of the Jharia coal field, lies the Chandrapura coal field, south and southeast of Chandrapura Railway station (23° 45′ N. and 86° 07′ E.). It has an area of about 400 acres, contains nine seams, and has reserves amounting to 15 million tons of inferior quality coal.

Mining commenced in the Jharia field in 1894 with the extension of the East Indian Railway, when the whole length of the coal field was brought into direct communication with the port of Calcutta. In 1894 the output from all the mines in Manbhum District was only 128,686 tons; in 1895 it rose to 1,281,294 tons, the enormous increase being almost entirely from the Jharia field. In 1901 the output was 2 million tons, and in 1906 production went up to 4 million tons. After 1907 coal production went up to nearly 7 million tons. The entrance of the Bengal Nagpur Railway into the Jharia field in 1904 and the subsequent extension of various loops and small branches besides innumerable sidings from the East Indian Railway and the Bengal Nagpur Railway, the doubling of the line from Barakar to Dhanbad, the opening of the Grand Chord Section of the East Indian Railway from Dhanbad to Gomoh in 1907—all have facilitated rapid development (Fig. 5). As a consequence of the opening up of the Dhanbad-Gomoh section of the East Indian Railway there was a rapid opening of new collieries. The number of the collieries increased from about half a dozen in 1891 to 222 in 1908. The maximum production of the Jharia coal field in 1919 exceeded 12 million tons, representing over 53 per cent of India's total output for that year.

The Bokaro coal field lies in the catchment of the Bokaro River, between longitudes 85° 25′ and 86° 05′, extending for 40 miles in an east-west and 7 miles in a north-south direction. The field can be divided into two: East Bokaro, east of longitude 85° 42′, and West Bokaro. So far mining operations have been chiefly concentrated in the East Bokaro portion and entirely restricted to the Kargali (100-foot thick) seam. C. S. Fox estimated that 1000 million tons of coal are available in the Bokaro field of which half is of good coking quality. There was a record production of 2 million tons in 1930 which represented 9 per cent of India's production for that year. New settlements and economic development followed the construction of the railway line in 1914 from Mahuda in Manbhum to Bermo in the Bokaro colliery.

The Ramgarh coal field is located about five miles to the south of the Bokaro coal field. It extends along the Damodar Valley between longitudes 85° 31′ and 85° 42′, and covers an area of about 40 square miles. It has been estimated that 5 million tons of workable coal is available over an area of at least one square mile. Development of this coal field has taken place recently.

The Karanpura coal fields are located a few miles to the west of the Bokaro coal field, between longitudes 84° 49′ and 85° 31′, in the Upper Damodar Valley. In this field there are two areas of Gondwana rocks, known as the North Karanpura coal field, which is 550 square miles in area, and the South Karanpura coal field, which is 75 square miles. The total quantity of coal available in the Karanpura fields has been estimated at 9500 million tons (8750 million tons in North Karanpura and 750 million tons in South Karanpura). The construction of the Barkakana-Daltonganj line of the East Indian

FIG. 6. Metalled roads. Modern buses operate throughout the year on these roads. Roads have greatly helped in the economic development of Chota Nagpur, particularly in areas not served by the railways.

Railway has brought the coal of this region to both the up and down country markets. Production commenced in 1925 and soon the output reached 2 per cent of India's total. Large areas of the North Karanpura coal field are inaccessible, being covered by dense *Sal* forest. In South Karanpura coal field some of the seams are of unusual thickness, one of them, Argada seam, is up to 90 feet. Most of the coal is mined from large open quarries. It is a good steam coal and is known to yield a fairly hard coke. The Karanpura coal fields have a bright future. New railways under construction will connect these fields with the markets of Madhya Pradesh (Central Provinces) and Eastern Uttar Pradesh (United Provinces).

Reserves of good quality coal in India, almost all of which lie in the Damodar Valley, are small and they are approaching exhaustion. C. S. Fox has estimated the reserves of good coking coal as only 1700 million tons (Jharia 900 million tons, Bokaro 320 million tons, and Raniganj 250 million tons). This is computed as great

enough to support the iron and steel industry of India for a period of 35 to 50 years, but under careful conservation a life of 200 years has been indicated. The present wasteful method of mining by the board and pillar method in most of the coal fields should be replaced by the sand stowing method. The coking coal which is at present used for steam raising and other purposes should be conserved for the iron and steel industry, as India possesses very large reserves of iron ore which would last for centuries whereas our suitable coal reserves are very limited indeed.

As has been said, the Damodar Valley is served by the East Indian as well as the Bengal Nagpur Railway (Fig. 5). The most accessible is the Jharia coal field, where collieries are served by a network of both these railway systems, and the inter-connection of the two systems at Gomoh, Katrasgarh, and Jharia makes it possible to dispatch coal to any part of India. Large parts of the Karanpura coal fields have very poor transport facilities. The East Indian Railway passes along the borders of the North Karanpura coal field and serves only a few mines of the South Karanpura coal field. These coal fields are located in the forest-covered hilly areas at higher elevation, which makes them less accessible.

Due to the abundance of coal, several manufacturing industries, particularly those connected with coal, have established themselves in the Damodar Valley, almost all located in the lower portion of the valley on the rich Jharia and Raniganj coal fields. The main industries are the manufacture of hard coke and its by-products, fire bricks, and glass. Coke and by-products, some of the most important of which are sulphate of ammonia, coal tar, and benzol, are manufactured at Lodna, Loyabad, Kusunda, and Jharia. The fire clay deposits occurring on either side of the Barakar River have given rise to important refractory industries located at Mugma, Barakar, Kumardhobi, and Jharia. The fire bricks manufactured at these places are used in the steel works at Jamshedpur and Kulti near Asansol. Glass factories are located at Bhurkunda and Ramgarh. The obvious reason for the growth of the glass industry is the availability of cheap fuel. Sand, which is the principal raw material, is imported. A gigantic chemical fertilizer factory was completed and went into production in March, 1952, at Sindri, situated on the banks of the Damodar River near Dhanbad on the Jharia coal field (Figs. 8 and 9). Industrially, the giant fertilizer factory, biggest of its kind in Asia, is expected to become the nucleus of the expanding heavy chemical industry. Agriculturally, the production of 350,000 tons of ammonium sulphate a year and other varieties of artificial fertilizers which the factory will produce is expected to help India in attaining her objective of self-sufficiency in food grains in the future. There is no difficulty in getting coke and coal as the factory is perched on the coal deposits of the Damodar Valley. The factory, however, is removed from gypsum deposits located at Bikaner and Jodhpur in Rajasthan. Sindri today is a modern township throbbing with the life of a busy industrial center and a monument to the new constructive spirit of India.

A multi-purpose scheme (DVC) similar to the TVA has been projected which will put the river Damodar to work and will aid further development of the whole region. The greatest benefit accruing to Bihar from this project will be the development of hydro-electric power on a large scale.

This will accelerate the progress of mining and manufacturing industries in the valley and the adjoining areas. Among other things, the project also aims to make the Damodar River navigable by regulating the flow by control dams and dredging of the bed. Ultimately, the project, if successfully carried on, may result in transforming the Damodar Valley and adjoining areas into the most industrialized region of the Indian Republic, a region of real world importance.

2. *The mica region*

The mica belt extending from the eastern part of Gaya District through the districts of Hazaribagh and Monghyr forms a distinct economic region. The belt is located on the northern fringe of the Chota Nagpur Plateau, and extends in a roughly southwest to northeast direction. The largest part of the mica belt falls within Hazaribagh District, and the most important area, supplying the bulk of the output, lies within the Kodarma Reserved Forest, a tract of about 56.90 square miles to the north of Kodarma (Fig. 12). In recent years the areas situated northeast of the Reserved Forest, near Gawan, and the field northeast of the Parsabad railway station have developed increasing importance. The chief centers of mica mining in Hazaribagh have been in order from the west the Kodarma Reserved Forest, Dhorakhola, Domchanch, Masnodih, Dhab, Gawan, and Tisri.

The belt coincides with the Dharwar outcrop (Fig. 3), and forms that portion of the plateau which descends by a series of ghats or scarps to the Ganga Valley. The rocks exposed in the mica belt comprise schists, gneisses (including the so-called "dome-gneiss"), mica-bearing pegmatites, and dolerite dikes. The numerous streams flowing down

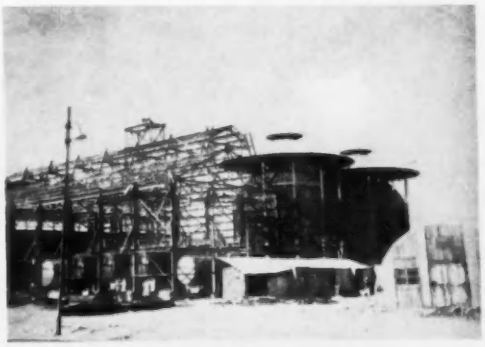
FIG. 7. View of a colliery at Jharia in Damodar Valley.

from the high and uniform mass of gneiss have carved out deep channels or ravines in the heterogenous and irregular formations of soft schist and hard granite, exposing the mica-bearing veins. The pegmatites, which are very important as they contain all the mica of economic value, have been intruded into the schists in the form of sheets and lenses parallel to the foliation. The mica occurs as "books" within the pegmatites. The present vertical range over which mica-pegmatites are known to occur is at least 1000 feet. Pegmatite veins have been worked to a depth of 500 feet. In the western portion of the belt veins of mica-pegmatites become thin and less frequent, and the mica obtained is of small size and inferior quality, e.g., near Chauparan and Gurpa. Besides mica, the pegmatites are remarkable for the large and varied assortment of minerals

found therein, viz., albite, tourmaline, beryl, garnet, quartz, columbite, and fluorite. The mica is considered to be of pneumatolytic and hydrothermal origin. Most of the mica mined is of ruby color.

The mica industry of Chota Nagpur is of enormous importance to India and the world. Chota Nagpur is responsible for 80 per cent of India's mica production valued at Rs. 6 crores (between 12 and 13 million dollars) in 1948. Nearly 70 per cent of the world's sheet mica comes from this belt. Chota Nagpur's ruby mica is regarded as the best mica for electrical purposes. More spectacular and impressive examples of modern dependence on mica are the radio, high compression air-plane motors, and heavy duty electric locomotives. Mica is irreplaceable in its applications and as such a constant and ample supply is indispensable for the maintenance and development of the evergrowing electrical, radio, wireless, and aeronautical industries.

The mica industry has been in existence for over 75 years, but, since 1919, improvements in transport facilities have been followed by enormous expansion. Real development of the mica belt took place after the construction of the railways in 1916, through Kodarma. Railway and roads have added a good deal in prospecting of the belt. The number of holders of miners' licenses in the belt is approximately 200, and about 650 mines have been



FIGS. 8 (upper left) AND 9 (upper right). Views of the fertilizer factory recently completed at Sindri, near Jharia, in the Damodar Valley. The factory is the biggest of its kind in Asia.

FIG. 10 (lower left). A mica mine near Kodarma. This is an "Uparchala" working or shallow mine.

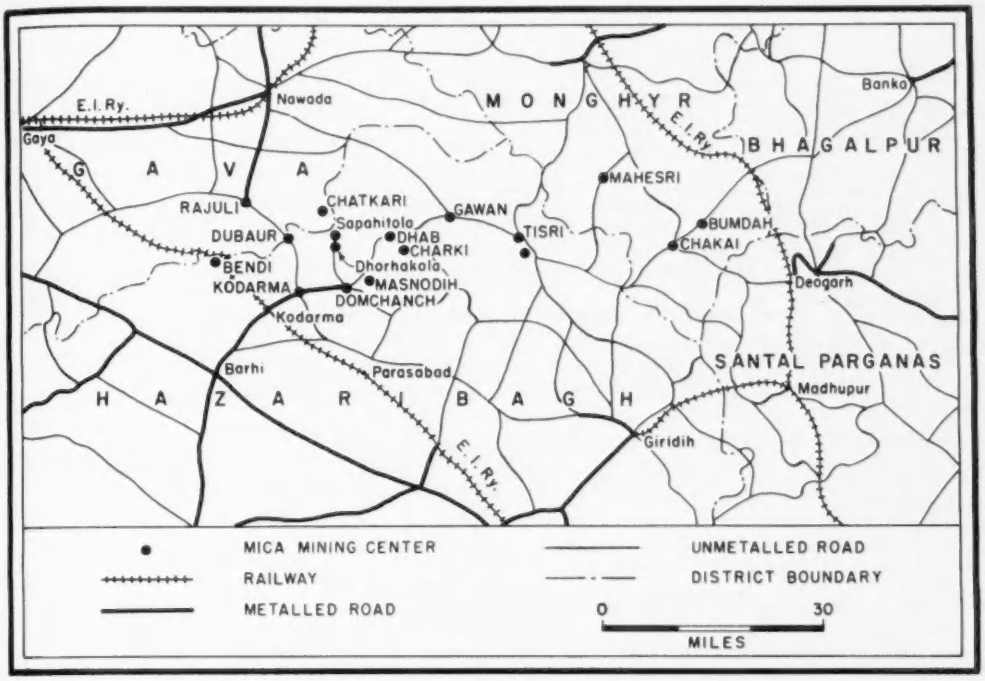
FIG. 11 (lower right). View inside the Kodarma Mica Factory. Workers are seen splitting and grading the mica.

notified under the Indian Mica Act. Up to 1918, most of the mica was obtained from "*Uparchala*" workings or shallow mines. These "Uparchala" or surface workings usually extend down to 20 feet (Fig. 10). Recently the "Uparchala" workings produced about 25 per cent of the mica raised in the entire belt. The "Uparchala" working carried on by smaller mine-owners is wasteful and irregular. Most of the larger properties are now being worked in a more systematic and scientific manner and have been mechanized. Except in the case of the larger and mechanically equipped mines which are worked throughout the year (provided they are accessible by road and are not subject to floods) operations in most mines start about November and continue during the winter and early summer months till May. The suspension of work during the rainy season is due to accumulation of water in the pits, bad condition of roads for transport, and deficiency of labor, which, being drawn mainly from the agricultural class, becomes scarce in this season.

Crude mica after its extraction from the mines is first sorted at the pit head according to size (big or small) and then dispatched to factories. In the factories crude mica is first opened with the blade of a double-edged knife, and the mica books are reduced to the required thickness (about ¼ of an inch). These books are then passed to the cutters to be dressed. The mica blocks thus prepared, which are up to ⅛ of an inch in thickness, are known as "sickle-dressed block" (S.D.B.). The sickle dressed mica is then sorted according to size and then as to quality. The larger sizes are usually exported as block mica. The smaller size is exported as splittings. Splittings are done mainly by women and children in their huts or factories (Fig. 11). The highest skill is required in the preparation of mica for the market. The number of persons employed in mica mines was about 46,431 in 1943. The number of workers employed in the "manufacturing" side of the industry is very considerable and was estimated to be about 35,000 and the home splitters about 100,000 in 1943.

The broken nature of the country, with its series of scarps, rapid streams, and ravines, has facilitated the detection of mica veins and the process of mining, but at the same time it has made transport difficult and costly. No railway passes through the main mica region. The two lines, viz., the Grand Chord and the Main Line of the East Indian Railway, skirt the mica region at its western and eastern ends. The former, however, runs close to the Kodarma Forest mica area, and Kodarma, being the nearest railway station, receives the mica mined in its vicinity. The railway is separated by rugged country from the increasingly important centers of activity northeast of the Kodarma station.

There is a deplorable lack of good roads. Metalled roads are almost absent in the mica region. Only a short metalled road connects Domchanch with Kodarma railway station. Rajauli, which is situated on the outskirts of the belt and where the production of mica is decreasing, is connected by a metalled road with Patna. All other roads inside the region are unmetalled tracks passing through very rugged country and crossing numerous streams, often rapid and unbridged. The mica has to be carried from the mines to factories, home-splitters, or railway stations as head loads, by pack bullocks, or on carts. In a very few localities motor trucks are used but they have to follow sinuous, unbridged roads, which adds greatly to costs.



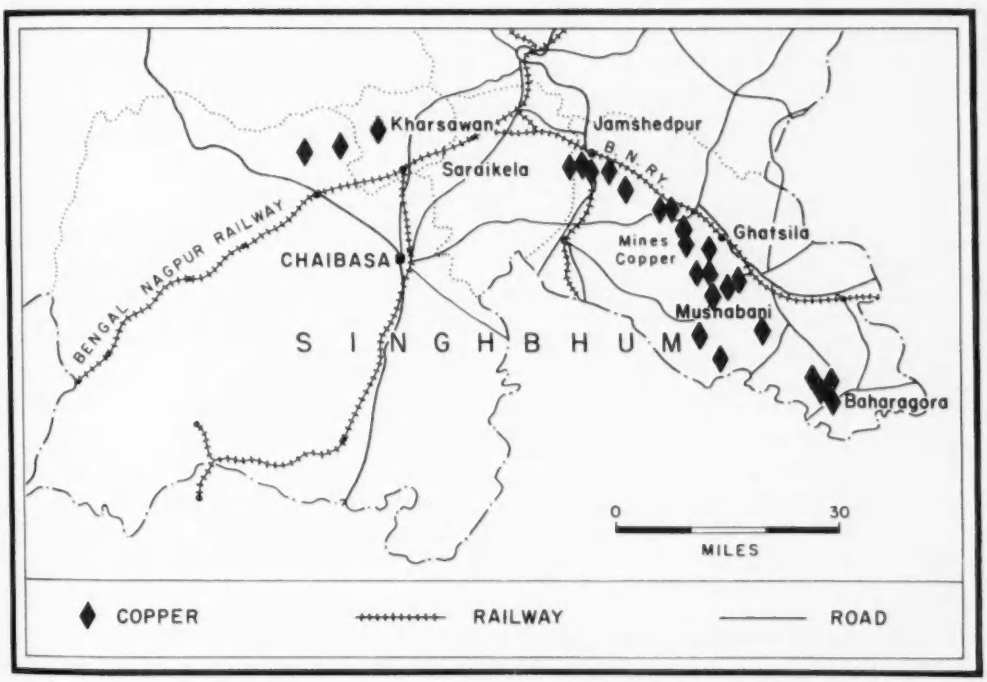


FIG. 12. The mica region, showing the mining centers, roads, and railways.
FIG. 13. The copper belt, showing mines, railways, roads, and the smelting center.

3. *The Singhbhum copper region*

The copper region (Fig. 13) in Singhbhum District forms a well marked economic region. The Copper Belt of Chota Nagpur, about 80 miles long, extends from Duarapuram in western Singhbhum through Kharsawan and Saraikela converging southeast through Rakha and Mushabani mines, and terminates near Baharagora. This geological copper belt does not coincide with the copper economic region which is restricted to the eastern part of the belt near the mining and smelting centers of Mushabani, Dhobani, Ghatsila, and Maubhandar.

The copper bearing rocks occur as veins along a zone of intense shearing due to Archean fold movements in the Dharwar schists and intrusive granites. These veins are best developed and form well defined lodes at Rakha mines, Mushabani, and Dhobani. At Mushabani the workings have been very successful; lodes are characterized by a solid vein of chalcopyrite and pyrrhotite, usually 9 inches wide but sometimes wider. The copper deposits of Singhbhum suffer from a failing which is common among ore deposits in Peninsular India, and that is a wide dissemination of abundant material instead of the concentration sufficient to reward exploitation in any notable degree.

The systematic and scientific development of the region has been done by the Indian Copper Corporation, Limited. The Corporation operates mines at Mushabani, Dhobani, and Badia. The development and prospecting of the copper region was greatly aided by the extension of the Bengal Nagpur Railway to this region. The copper smelting center at Ghatsila is only 132 miles from Calcutta.

The ore is taken out to the surface and is crushed. From the primary crushing plant, the crushed ore is carried by a belt conveyor to the aerial ropeway line and from there by ropeway a distance of six miles to the concentrating mill and smelter at Maubhandar. The whole process is automatic. An assisted siding connects the plant site with the Bengal Nagpur Railway main line at Ghatsila. In 1940 the production of copper ore and refined copper was 406,076 tons and 6650 tons respectively. Deposits of talc occur at intervals along the copper belt, and are mined in a small way.

Although there has been exploitation of the copper belt in the most important section, viz., the Rakha-Mushabani-Dhobani area, there is still a great scope for smaller companies to prospect other parts of the belt. Prospecting on new sites, however, may not yield so much copper ore as to justify the erection of another smelting plant. In the interests of the industry, therefore, any production outside may be sold to the Corporation for smelting.

The chief factor responsible for the non-exploitation of the other parts of the copper belt is the absence of good transport facilities in the rugged and hilly area of eastern Singhbhum. Only the well developed lodes at Rakha, Mushabani, and Dhobani, which are accessible in terms of modern transport, have been developed as yet. The Union Government has planned to build National Highways passing through the region, while the State Government of Bihar has plans to construct major district roads in this area. The construction of these roads will, undoubtedly, increase the accessibility of the region, which may lead to the prospecting and further development of the copper region. In view of the national importance of such a metal as copper every opportunity should be

taken to develop the industry through the betterment of transport facilities.

4. *Kolhan iron ore region*

The Kolhan iron ore region is mainly a mining region, and comprises the hilly areas of Kolhan and Porahat in the southern and western parts of the Singhbhum District. The region extends approximately from the valleys of the Karo and South Koel Rivers in the west to Chaibasa in the east. The human activities here are concerned with the mining and transport of minerals obtained from the area, apart from a limited agriculture and forestry. The region contains various kinds of mineral pigment, corundum, limestone,

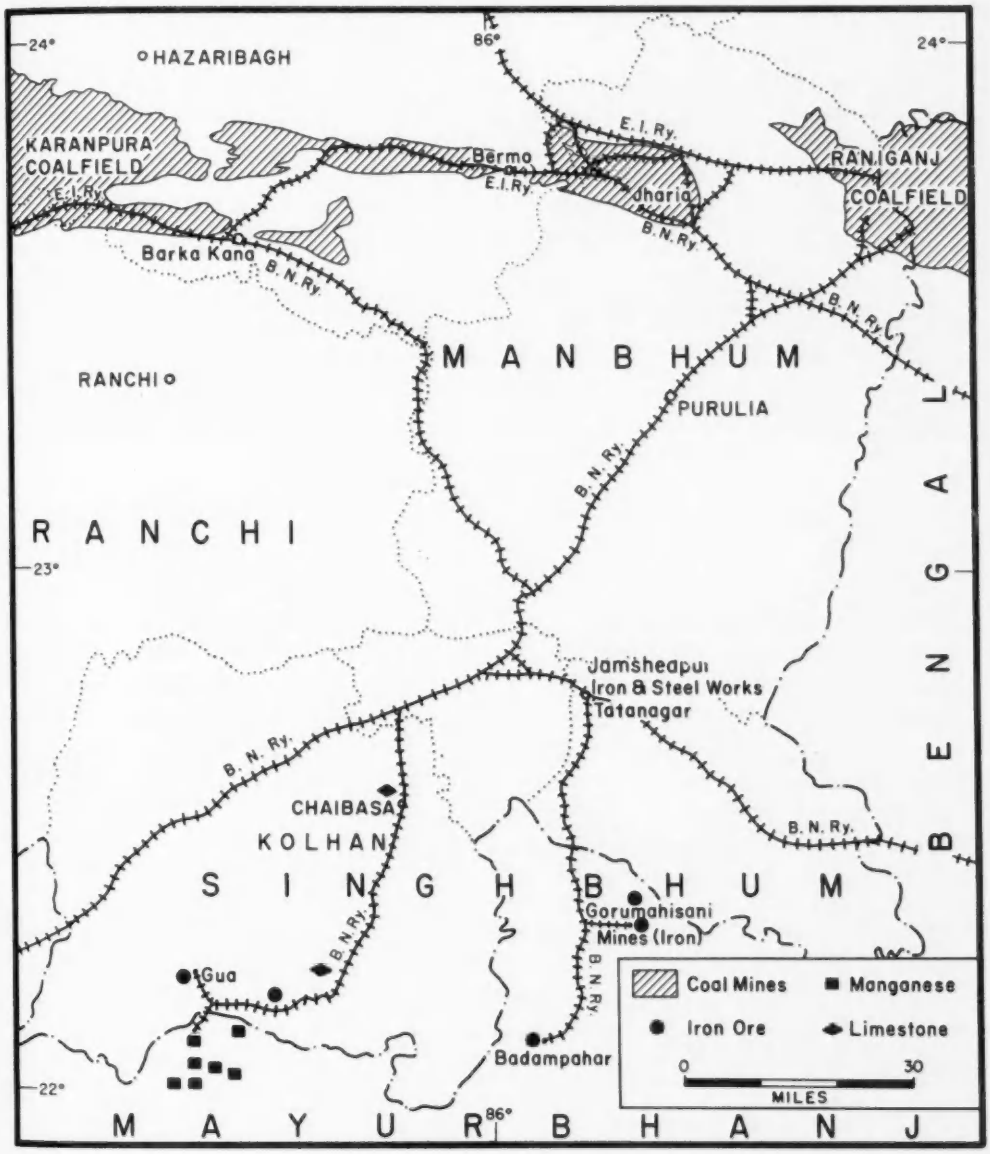


FIG. 14. The iron and steel works at Jamshedpur are centrally located in relation to the raw materials—coal, iron ore, manganese, and limestone.

and other minerals of varied economic importance, as well as some of the richest and most extensive deposits of iron ore in the world.

Besides the main range of hills, there are numerous isolated hills, low ridges, and dikes in this part of Chota Nagpur. The hilly ranges extend northward, but are not connected with the Ranchi Plateau. There is a remarkable break to the north where the ridge dies away and leaves a pass a little over 1100 feet high between these hills and the spurs of the Ranchi tableland. This natural gap is occupied by the Bengal Nagpur Railway.

FIG. 15. Tata Iron and Steel Works, Jamshedpur.

Geologically the region consists of metamorphic and relatively unmetamorphosed sedimentary rocks, with which are associated basic igneous rocks and large intrusive masses of granite. The sedimentary rocks include sandstones, conglomerates, limestones, shales, phyllites, mica schists, quartzites, and banded hematite-quartzites. Associated with the last are some of the very rich and great deposits of iron ore, and these have made Kolhan region one of the most important economically in India. The group of rocks among which the iron ores occur is designated the Iron-ore Series. The rocks of the Iron-ore Series in Kolhan occupy steep, sparsely inhabited, forest covered hills, the tops of which form the remains of an old peneplain at about 2000 feet above sea level, and were presumably at one time continuous with the Ranchi Plateau to the north. The higher ridges rising to nearly 3000 feet consist mainly of banded hematite-quartzite and iron ore. The banded hematite-quartzites crop out as ridges, arranged in the form of a narrow horseshoe with a closed end to the south in Keonjhar and Bonai, and with sides open to the north in Singhbhum and about eight miles apart. The ridge forming the western side of this horseshoe is known as the Iron Ore Range. The banded hematite-quartzite of Singhbhum is very much like the jaspilite of the Lake Superior region and is pre-Cambrian in age.

An enormous amount of ore, dipping at about 70° to the northwest or west, is present in the Iron Ore Range, stretching for about 30 miles from north of Gua in Kolhan to Rontha in Bonai, with a breadth varying from 400 to nearly 1000 feet, and rising some 1500 feet above the level of the plain. Ore averaging over 60 per cent iron occurs throughout the whole of this length. Small parallel ranges also contain good ore. Practically the whole of the ore mined consists of hematite, varying in consistency from a massive steel-gray type with 69 per cent of iron, through a porous, laminated, shaly type produced by the leaching out of the siliceous layers from the banded

hematitic quartzite and carrying over 60 per cent iron, to a fine soft powder with quantities ranging up to 69 per cent of the metal. All three types pass gradually one into the other. Jones has estimated that a minimum of 1000 million tons of ore, averaging not less than 60 per cent iron, crops out at the surface within Kolhan. For the whole of Singhbhum and the adjacent areas (Mayurbhanj, Keonjhar, and Bonai) in Orissa, the minimum estimate is about 3000 million tons of high grade ore. Recent research work carried out by F. G. Percival has shown that the reserves of iron ore may be of the extent of 8000 million tons rather than 3000 million tons. Percival has further concluded, "Later discoveries of deposits below alluvium, at present unknown, may necessitate an increase on this estimate in future."[2]

The main iron ore deposits worked in the region are five in number. Of these five, Noamundi deposits are worked by the Tata Iron & Steel Company, while the rest (at Pansira Buru, Budu Buru, Gua, and Jhiling Buru) are mined mainly by the Indian Iron and Steel Company. At Noamundi, where the Tata Iron & Steel Company mines iron ore, the ore bodies occur in two parallel north-south ridges, each about two and a half miles long. It has been estimated that at least 300 million tons of ore are available in these ridges covered for the most part by forest. Hard massive ores, soft shaly ore, and powdery ore or "blue dust" are all found at Noamundi. In 1944 the Tata Iron & Steel Company produced 704,251 tons of iron ore from Noamundi mines. The average number of laborers both men and women employed at Noamundi total 2000 to 2500. At Gua, the main deposits are on the high ridge to the west, which contains at least 100 million tons of ore. Another deposit, at Jhiling Buru, occurs immediately to the south of Gua. The deposit at Pansira Buru 12 miles southeast of Manoharpur has now been exhausted. The reserves at Budu Buru mines, eight miles southeast of Manoharpur, amount to at least 150 million tons of high grade iron ore averaging 64 per cent iron content.

The development of the iron ore deposit of Kolhan followed closely the construction of the railways. Before the advent of the railways, Kolhan was an undeveloped hilly tract covered with forest for a large part. The extension of the Bengal Nagpur Railways in the early decades of the present century opened a large area of Kolhan and Porahat, resulting in mining development and the consequent rapid wave of settlements in the area. The Noamundi mine is connected by a railway siding with the Raj-Kharsawan-Gua extension of the Bengal Nagpur Railways. This branch line runs from Amda on the main line through Chaibasa to the south of Singhbhum. The line lies in the eastern part of the hilly country, and from it several branches lead to the various iron ore deposits of the region. The iron ore of the Tata's are sent by rail to Jamshedpur and those of the Indian Iron & Steel Company to the smelting works at Kulti near Asansol in the Damodar Valley. A large area in the interior is still inaccessible in terms of modern transport due to the hilly terrain and dense forests. First class metalled roads are lacking in the area, except the one from Chaibasa to Gua (Fig. 6). Development of transport facilities in the region is a sin qua non for further economic development.

Besides iron ore, manganese ores

[2] "Estimated Reserves of Iron Ore in Singhbhum–Orissa Field," Transactions of the National Institute of Sciences, India, Vol. II, 1947, pp. 373–375.

FIGS. 16 (upper left) AND 17 (upper right). Modern metalled roads such as these at Jamshedpur connect all the large urban centers of Chota Nagpur.

FIG. 18 (lower left). Factories at Dalmianagar in the Son Valley industrial region.

FIG. 19 (lower right). The bullock cart is still an important means of transport in rural areas where roads are not suitable for motor transport.

have been worked in southern Kolhan, in the area between Noamundi and Gua. The manganese deposits of Kolhan occur mainly in the phyllites of the Iron-ore Series. Manganese ores are found either as thin lenticles in phyllites or irregular masses in cherts, and as manganiferous surface laterite. The small known manganese deposits are worked according to market demand in Kolhan. The manganese ore is mostly railed to iron and steel works at Jamshedpur. It is possible that further deposits of manganese may be found in the future in the as yet unsurveyed and thickly-forested areas of Kolhan.

Another mineral of relatively less importance is limestone. The outcrop of limestone extends for nearly 30 miles from Chaibasa to Jagannathpur. The limestone is of variable thickness. It has a thickness of 40 feet near Rajankar where it is quarried by the Tata Iron &

Steel Company for use in the steel works at Tatanagar (Jamshedpur). This limestone is also used for cement manufacture at Jhinkpani southwest of Chaibasa.

As noted earlier, the Kolhan region of Chota Nagpur is thickly forested. The forests of the area support an important vegetation industry, i.e., cultivation of lac and manufacture of shellac. Lac is a secretion produced by the lac insect (which belongs to a group of insects called *Caccides*), and deposited on the twigs of suitable trees, of which the principal are the *kusum* (*Schleichera trijuga*), the *palās* (*Butea frondosa*) and *bair* (*Zizyphus jujuba*). *Kusum* and *bair* trees are in considerable numbers in the forests of Kolhan. Lac is propagated by tying twigs covered with the encrustation produced by the insects, at the correct season, to suitable trees. The insects spread over the trees, and when the depositing of lac is finished, the small branches with their load of lac are cut off, and the lac is scraped from the wood. The lac is produced mostly on trees growing in the forests around the villages and on uncultivated land. The raw lac is purchased by the factories, and is crushed, cleaned, heated, turned into sheet lac by skilled workers, and ultimately converted into shellac by melting. The melting is done by charcoal fire in an oven-shaped fireplace (locally called *bhattā*). Chaibasa and Chakradharpur are the two chief shellac manufacturing centers in this region, and the total number of factories has been estimated to be 10 with a total of 163 *bhattas* (fireplace for melting lac to manufacture shellac).

Although this region produces lac and shellac, it is needless to mention that this is mainly a region of mining industry.

5. *Iron and steel and heavy industrial region around Tatanagar (Jamshedpur)*

This iron and steel and heavy industrial region around Tatanagar lies in the Subarnarekha Basin. The economic activities here are concerned with the smelting of iron ore and the manufacture of iron and steel and heavy engineering products. Modern smelting started at Sakchi (now named Jamshedpur) with the iron ores discovered at Gurumahisani in the Mayurbhanj State. The first operations commenced in 1911. Several subsidiary industries have established themselves around Tatanagar during the last 20 to 30 years. Rapid expansion of the iron industry followed, in 1919, the discovery of the vast hematite deposits in Kolhan. Since 1926–27, Tatas have utilized iron ores from Kolhan (Noamundi deposits) for a large part of their requirements.

Within a few years of its establishment the company became the leader in the production of pig iron, and the pioneer in the manufacture of steel and steel products in India. The total quantity of pig iron produced by the company amounted to 162,282 tons in 1914, and increased to 1,091,219 tons in 1939. The output of steel also rose from 67,000 tons in 1914 to 777,000 tons in 1939. During World War II the expansion continued. Bars and structural steel, rails and fishplates, galvanized sheets, heavy structurals, plates, blooms, billets, sheet-bars, black-sheets, sleeper bar, and sleepers are some of the important products produced by the company.

The leading position of Tatanagar in respect of the iron and steel industry of India is profoundly linked with the geography of the region and the richness of the adjoining areas in coal and iron ore resources. The geography of Jamshedpur and the adjoining areas

has given it a definite advantage. The South Koel and Sanjai Rivers have carved out a gap between the Ranchi Plateau (on the north) and its south easterly component in Orissa, which has been utilized by the main line of the Bengal Nagpur Railway connecting Jamshedpur with Peninsular India. The meeting of the valleys of the Kharkai and Subarnarekha Rivers affords the widest level area in an otherwise rugged region. The site is underlain by mica schist furnishing suitable foundation for the erection of a steel plant. The Subarnarekha Valley, through which the main line of the Bengal Nagpur Railway passes, gives it easy access to Calcutta, about 150 miles to the east. The Kharkai Basin, to the southwest of Jamshedpur, surrounded on three sides by the iron deposits of Mayurbhanj-Singhbhum, gives easy access to the ore-bearing hills flanking the basin, and has also facilitated the exploitation of the manganese deposits in Singhbhum. The Subarnarekha River provides water supply to the steel company and allied works.

Both in relation to two important raw materials—coal and iron ore—as well as to its largest market, Calcutta, Jamshedpur has a central position (see Fig. 14).

A large portion of the coal consumed by the works comes from the Tata's collieries, situated in the Jharia coal fields at a distance of little over 100 miles to the north from Jamshedpur. In 1945, the total output of coal from the company's collieries amounted to 941,532 tons. Although the coking coal resources of India are small and are estimated to last not more than 65 years, the Tata Iron & Steel Company by acquiring several large coal properties and working them on sound lines has to some extent insured itself against a probable shortage of this vital raw material in the future.

Jamshedpur, the seat of the iron and steel industry, is located fairly close to the "Iron Belt" of India. The modern iron and steel industry is based on the very rich and extensive hematite ores of this "Iron Belt" in Singhbhum, Mayurbhanj, Keonjhar, and Bonai. The iron deposits extend from Gorumahisani in Mayurbhanj westwards through Keonjhar and Bonai to Kolhan in Singhbhum. "Both in quantity and quality these ores are thought to exceed any other ores of the same kind, including the great American occurrences of Minnesota, Wisconsin and Michigan."[3] (The mode of occurrence of the iron ore and the total amount available have been discussed under Kolhan region). Besides Noamundi mine, the Tata Iron & Steel Company works ore deposits at Gorumahisani, Sulaipat, and Badampahar in Mayurbhanj. In 1914, the Tata Iron & Steel Company produced 284,602 tons of iron ore from these mines which increased to 1,658,993 tons in 1944. Mayurbhanj has always been the largest supplier of iron ore to the steel works at Jamshedpur. Gorumahisani mines of Mayurbhanj were the first to be opened by the company (in 1911). Gorumahisani, together with the other mines of Mayurbhanj, supplied practically the whole of the requirements of the iron ore to the company before the opening of the Noamundi mine in 1926. The Gorumahisani deposit occurs at a distance of 38 miles from Jamshedpur and is the nearest mine to the works. The average iron content of the ore is 63 per cent. Sulaipat ore deposit is situated about 12 miles south of Gorumahisani mine. The metallic content of the ore

[3] C. S. Fox: "Mineral Resources of India for a Domestic Steel Industry," Report of the Indian Tariff Board, Steel Industry, 1924, p. 91.

dispatched from here is very high averaging 65 to 69 per cent. Badampahar ore deposit occupies the hill of the same name and is at a distance of about eight miles southwest of Sulaipat mine. The iron content of the ore averages from 56 to 58 per cent. All these mines have been connected by means of tram lines or railway sidings to the extension of the Gorumahisani line, which is a branch of the Bengal Nagpur Railway and was constructed for the special purpose of tapping the mines in the locality. (The Noamundi mine has already been discussed under the Kolhan region.)

Limestone is by far the most important fluxing material used in the iron and steel works at Jamshedpur. Most of the limestone deposits in Kolhan are small in size and poor in quality. The company, therefore, obtains the bulk of its limestone supplies from the eastern districts of Madhya Pradesh (formerly called Central Provinces) and dolomite from Gangpur to the west. The Panposh quarries lie at a distance of about 95 miles from Jamshedpur on the main line of the Bengal Nagpur Railway, and are the nearest large deposits of dolomite owned by the company.

Manganese is another material used in the manufacture of iron and steel. The Tata Iron & Steel Works get their supply of manganese from the nearer Singhbhum, Keonjhar, and Bonai deposits, which are about 110 miles from the steel center.

The rail and road transport has played an important role in the development of Tatanagar, the steel city of India. They bring iron ore, coking coal, and other materials, and again transport the finished products to the different parts of the country. The railway transport enters the very fabric of the industry.

Due to the establishment and growth of the industry the modern city of Jamshedpur, with a population of 218,162 (1951 Census), has sprung up over an area of 25 square miles from a tiny village of Sakchi containing a few huts.

The chief industrial zone of the city lies to the north of the Bengal Nagpur Railway line. This industrial section of the city, covering an area of about 2½ square miles, contains the "master plant," viz., the Iron and Steel Works, and is quite apart from the residential section where markets, schools, hospitals, parks, and playgrounds are located. The Iron and Steel Works (Fig. 15), contains the coke ovens; five blast furnaces; open-hearth, Duplex, and electric steel making furnaces; rolling mills; boiler plant; sheet mill; plate mill; and bar mill. The New Research and Control Laboratories of the Tata's are also located here. The National Metallurgical Laboratory of the Ministry of Scientific Research is also located nearby.

The other factories of Jamshedpur are located in the eastern suburbs away from the city as well as from one another. This area also contains the residential quarters of the workers. The Indian Hume Pipe Co., Indian Cable Co., Agricultural Implements Co., Tinplate Co., Indian Steel Wire Product Co., Machine Manufacturing Co., Locomotive Workshop, and other secondary iron and steel manufacturing factories are all situated to the east of the main city. These factories and adjoining settlements of the workers have been built only on level plots.

6. *The Son Valley industrial region*

The Valley of the Son River in the districts of Shahabad and Palamau forms a well-marked industrial region in the northwestern fringe of the Chota Nagpur Plateau. This area is important for limestone quarrying, cement

and paper manufacture, and several other industries. Dalmianagar (also called Dehri) is the industrial pivot of the region.

The area possesses immense industrial potentialities and locational advantages. The important resources of the region for industrial development are the rich limestone deposits of the Kaimur Plateau, glossy sand, abrasives and grinding materials, and clay. Dalmianagar, the industrial focus of the region, and some of the main highways of commerce of northern India are located on the East Indian Railway. The coal fields of the upper Damodar Valley and Daltonganj are very close to the region.

The cement manufacture of the region, which is located at Dalmianagar and Japla and is the most important industry of the area, is now discussed.

The raw materials of the cement industry, viz., the limestone and clay, are obtained from the Rohtas Plateau (also called the Kaimur Plateau), whose steep eastern scarp overlooking the plain of Shahabad extends from the Son Valley to the boundary of Bihar with Uttar Pradesh (formerly known as United Provinces). This plateau is the easternmost termination of one of the most pronounced geographical and geological features of India, the vast area constituting the Vindhyan Tableland. The plateau consists of practically horizontal beds of limestone and sandstone. The limestone, which supports the cement and lime industry of the Son Valley, forms the topmost *Rohtas stage* of the *Semri series* belonging to the Lower Vindhyan geological formation of India. The limestone at Rohtasgarh has been quarried since 1847. Mallet,[4] in 1869, described the quarrying and lime-burning industry here and the transport of lime via the Son River and the Ganga. Since those days, the industry has gradually increased in the Son Valley. The opening of the Dehri-Rohtas Light Railway (1913) led to the establishment of several factories to work the Rohtas limestone at and near Banjari. Limestone is quarried mainly for the manufacture of cement and lime.

The manufacture of cement, localized chiefly due to the availability of raw materials (other than coal) in the immediate vicinity, began in 1922 with the establishment of the Son Valley Portland Company. The factory is situated three miles from the Japla Station on the Daltonganj-Son-East Bank branch of the East Indian Railway, with which they are connected by a rail line. The limestone comes from deposits south of Rohtas and is brought to the factory across the Son River by means of a five-mile-long ropeway. Clay is found nearby and is brought over a tram line. The coal is obtained from the Rajhara coal mines in the Daltonganj coal field, which is 39 miles away.

Another large cement factory was established at Dalmianagar just before the second World War. In 1945, another cement factory was started at Kalyanpur in the Son Valley. All these factories are admirably situated with respect to the main raw materials required for cement manufacture. There is a plentiful supply of cheap labor in the vicinity of the factories. They are also favorably situated in respect to the consuming centers, particularly those in the Ganga Valley.

The other chief industry of the valley is the manufacture of paper based on the forest resources of Chota Nagpur. The paper factory is located at Dalmianagar, and has an advantageous

[4] F. R. Mallet: "The Vindhyan Series," Memoirs of the Geological Survey of India, Vol. VII, Part 1.

location in respect of availability of raw materials, supply of water, and the facilities for power, transport, and marketing. Bamboo, which is the main raw material used in the paper mills, occurs abundantly on the scarps of the Rohtas Plateau and on the hills of the adjoining parts of Chota Nagpur. The railway line (Barka Kana-Daltonganj-Dehri), which runs along the North Koel and Son Valleys and joins the Grand Chord line of the East Indian Railway at Son-East-Bank lying just opposite to Dalmianagar on the eastern bank of the Son, serves as the main means of transport. The railway line running along the North Koel and Son Valleys helps in the exploitation of bamboos growing on the adjoining hills. The Son and the North Koel Rivers provide an excellent means of transport for the large rafts of bamboos which are sent to Dalmianagar. Fuel is obtained from the Jharia coal fields. Most of the chemicals used in the paper industry are produced in the local chemical factory. Dalmianagar paper mill, being the only mill in Bihar and eastern part of Uttar Pradesh, commands a vast market. The paper mill at Dalmianagar produced 9772 tons of paper in 1944.

Dalmianagar is also the seat of a sugar industry. The factory is located within the cane-growing area of South Ganga Plain, and attracts most of the cane produced in Shahabad District, and also from the Gaya, Palamau, and Patna Districts. Cane is brought to the factory by waterways (rivers and canals) and railways as well as by trucks and carts.

Other important industries at Dalmianagar, includes the chemical industries manufacturing caustic soda, chlorine, bleaching powder, synthetic hydrochloric acid, sodium sulphide, etc. A soap factory, a large vegetable oil factory, a saw mill, and a pole and pipe factory have recently been established at Dalmianagar.

Dalmianagar, the industrial pivot of today, was an unknown spot in the Son Valley before the advent of the railways. The transport of building materials, however, was done along the Son River, which was then the main artery of transport. In its present state, the Son is not considered navigable for steamer traffic, but the river can be made navigable after dredging and then may become of great commercial importance. The navigable length of the river varies with the different seasons. In the rainy season (July to October) it is navigable for 50 miles and in winter (November to February) and in dry season (March to June) it is navigable for 35 to 40 miles and 25 to 30 miles respectively above the anicut (dam) near Dehri.

There is great possibility of further industrial expansion in the Son Valley.

7. *Giridih coal and mica industrial region*

Around the Giridih coal field in the Hazaribagh District lies an important economic region. The main activities of the people are coal mining and the mica industry. Giridih is the industrial center of the area around which the economic activity revolves.

The region forms the easternmost extension of the Hazaribagh Plateau and has a general elevation of about 1100 feet. The surface is undulating, and the scattered rocky ridges disclose the severity of the denudation to which this ancient land surface has been exposed.

The coal bearing Gondwana rocks occupy an area of 11 square miles but the area covered by the productive measures is only seven square miles. The coal field has been preserved from erosion by the accident that it was dropped a little lower than the sur-

rounding country by the faults which bound it on the north and south. The important coal beds are the Lower Karharbari seam varying between 10 to 24 feet in thickness, the upper Karharbari seam varying from 4 to 10 feet and now almost exhausted, and Bhadoah seam 6 feet thick. The coal has a high calorific value, and is used on the railways and some is converted into coke. In 1934 Fox estimated the total quantity of coal available at 49 million tons and the life of the coal field at 25 years. The coal mining activity, however, will not cease suddenly. There will be a prolonged period during which the output will dwindle. Even now the poorer seams have begun to be exploited.

The labor employed in the coal field is entirely indigenous. For many miles around many of the villagers follow a dual occupation, working in their fields in the season of planting and harvesting, and coal-cutting for the rest of the time.

Coal mining in the field commenced as early as 1857, but vigorous development took place only after its connection with the main line of the East Indian Railway in 1871. The maximum output of coal from this field was reached in 1919 when slightly under one million tons were produced, nearly 4 per cent of India's production in that year. This industrial region has comparatively good transport facilities both as regards railways and roads. Availability of transport facilities appears to be an important factor in the growth of industries in the region. Giridih has a number of mica factories, where mica is brought from the mines in the adjacent "mica region" for processing. A modern plant for coke manufacturing and by-products is also located at Giridih.

8. *Daltonganj coal region*

The Daltonganj economic region comprises the area around the Koel Valley coal fields of Daltonganj, Hutar, and Auranga. The area is hilly and dissected, covered for the most part with forests. The hills are remarkable for their irregularity of outline and system, consisting of a series of peaks and ranges, the general trend of which is from east to west. Their contours depend upon the nature of rocks of which they are composed. The forest clad hills, the bold scarps in the highlands, the rocky beds and rapids of the numerous streams which dry up during the hot weather and come down in spate during the rains, all combine to make the region inaccessible. The roads and paths wind about and follow the bank of brook or water course, which, emerging from the fastnesses and gorges among the hills, winds in and out till it joins the stream that waters the valley below. Partly because of this inaccessible character, the coal fields of this area have not been exploited except the Daltonganj field which has been worked for many years.

The Daltonganj field is situated in the valleys of the Koel and the Amanat Rivers just to the north of Daltonganj. The coal-bearing rocks occupy an area of 32 square miles. The seams are usually thin, but at Rajhara a seam is 29 feet thick. The coal is mined at Rajhara. In 1901 Daltonganj was connected with the main line of the East Indian Railway at Son-East-Bank, which resulted in much accelerated production of coal in the field. The field is now within easy reach of Kanpur and other manufacturing centers of Uttar Pradesh.

Hutar field lies in the valley of the North Koel River about 12 miles west of the Auranga field, and has an area

of about 80 square miles. Several seams occur and the coal is of average quality.

Auranga field, traversed by the Auranga River, has not been worked as yet. There are numerous coal seams, some of which attain considerable thickness, but the coal is of inferior quality.

Daltonganj is the regional center of the area, and performs the important function of serving as a market for the produce of the region. A number of new railway lines which are under construction will open the fields of this area to the markets of Madhya Pradesh.

AGRO-ECONOMIC REGIONS

Before the study of the economic geography of the agro-economic regions, it will be better to mention briefly the salient features of their economy.

Agricultural economy in Chota Nagpur is predominantly of a subsistence type and only a small part of the farm produce is sold away from the locality of its production. As most of the cultivated land is required to produce food grains, the animal industries have developed only moderately. Generally the cultivators possess an uneconomic and unconsolidated holding which consists of tiny fragments of land scattered over the village. Agricultural practices in Chota Nagpur Plateau present a contrast to those of the Ganga Plain to the north, where agriculture is of an intensive type characterized by a high proportion of labor applied per unit area and a fairly high proportion of double-cropping.

The major physical factors affecting the agricultural potentialities of the various districts of Chota Nagpur are relief, soil, and climate. Relief is a prohibitive factor to successful farming in only limited areas of Chota Nagpur. Over much of the plateau the broken or undulating nature of the topography places a limit on the potentialities of the land and calls for a special adjustment of farming practices. The relief factor, including the closely related factor of shallowness of soil, attains its maximum importance in the western Ranchi and Palamau Districts (Fig. 2).

The most important natural factor, however, determining the character of agriculture is the climate—the typical monsoonal rhythm. The entire agricultural life of the area, viz., the types of crops, the agricultural calendar, the nature of agricultural water supply, the methods of tillage and farming, are adjusted to the seasonal cycle consisting of a relatively short rainy season (from the end of June to mid-October) followed by a cool dry period (November to February) giving place to hot summer (March to mid-June).

Rice is the dominant crop in the rural economy of the plateau, and due to the uneven topography the paddy fields, except on the valley floors and alluvial basins, are terraced. The terraced plots, owing to the difficulty of levelling on the hill slopes, are as a whole narrow strips of smaller size than the average in the Ganga Valley. A section from the valley bottom to the ridge top presents the following sequence: there is the irrigated paddy on the moist plain on the floor of the valley, this is succeeded above by a terraced slope given to rice, the terraced zone is followed

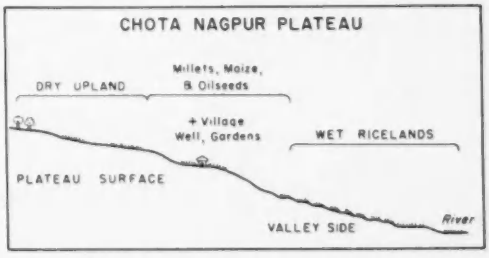


FIG. 20. A typical section from the valley bottom to the ridge top, showing the rice lands at the floor of the valley and on the terraced slopes of the valley side, followed higher up by a zone of dry uplands growing millets, maize, and oil seeds.

FIG. 21. Forests of Ranchi District which are the source of the timber as well as raw lac.

higher up by a zone of dry crops, e.g., millets, which is followed by forest or waste. Near the village or hamlet crops needing special care, e.g., vegetables or maize, are grown (Fig. 20). The chief rice producing areas are the Ranchi Plateau, the wider valleys and unwooded level tracts of Hazaribagh, the Koel Valley in Palamau, the valleys and terraced slopes of Santal Parganas, the rolling plain of Manbhum, and the lower Subarnarekha and Kharkai Rivers.

Before the advent of the monsoon the terraced fields present a dreary landscape, overgrown with stunted, withering grass. Early in the monsoon season after a downpour the fields are wet, and the period of brisk agricultural activity begins. The inundated fields are plowed and after a short interval the seedlings are transplanted in the muddy and inundated fields mainly by women. By the middle of the rainy season, the agricultural scene becomes pleasing with green paddy fields all around. In extensive level areas, e.g., Ranchi Plateau, there are vast stretches of bunded paddy fields resembling the landscape of the Ganga Valley, except for occasional hills or domes. With the arrival of the cold season the landscape becomes yellow with the ripening crop. During harvest time, the fields swarm with the smiling faces of peasants, both men and women, cutting and binding the crop. The harvest is transported to the village threshing ground (for crushing and winnowing) which is the main center of agricultural activity for a month or so. Most of the processes needed to render paddy fit for consumption is carried on in the homes and the work is mainly done by women. After crushing and winnowing, husking of rice (i.e., removal of the outer husk which covers the rice kernel) is done by hand-pounding, involving a large amount of labor. Hand-pounding is done by mortar (*Ukhli*) and pestle

(*Musal*). Paddy is placed in the mortar and pounded by pestle which cracks the husk so that the grain comes out.

In all the agro-economic regions, there are some rural industries carried on on a cottage basis to meet the simple needs of the rural population. These village industries are diverse and include oil-pressing, hand loom weaving, brick making, potter's earth industry, and several other miscellaneous activities. An oil-pressing industry is found in every large village. The oil seeds are crushed in *Kolhus* driven by bullocks and oil is obtained for local consumption. The hand loom industry—still important in the villages—produces coarse (*motia*) cloth, such as saris (women's garment), dhoti (men's garment), and pieces of cotton cloth. The coarse cloths are used all over the plateau by the rural population who are mostly aborigines. Ranchi and Hazaribagh are the principal urban centers for the hand weaving industry. The manufacture of bricks is important in some of the larger villages. Suitable clay for the manufacture of bricks is obtained from the fields or river banks. The brick is manufactured mainly in the winter season, when there is no likelihood of rain to damage the raw bricks. Various kinds of earthen pots—cooking pots, pitchers, earthen jars, cups, plates, water pots, and flower pots—are manufactured in the villages by the potter. These products find a ready market in the village and are purchased by the poor peasants who cannot afford more than the earthen wares.

After this brief study of the general features of the economic geography of the rural areas of Chota Nagpur, the detailed discussion of each agro-economic region follows.

9. *The Ranchi Plateau*

The Ranchi Plateau covering an area of about 4500 square miles in the heart of Chota Nagpur forms a distinct region. A long range of hills, in the form of an arc, forming the eastern edge of the "Western Higher Plateau," bounds the area on the west. In the north it is separated from the Hazaribagh Plateau by the Damodar Basin, while the middle valley of the Subarnarekha and the valley of Kharkai delimit the region towards the southeast. The average elevation of the plateau is about 2000 feet. The plateau is an undulating area intersected with numerous streams and studded with low wooded hills and by isolated peaks which form conspicuous features of the landscape. The area is composed mostly of granite and gneiss and inclusions of older Dharwar rocks. The soils derived from them are red owing to oxidation. There are great variations in consistence, depth, and fertility of the soils. A large proportion of the ground, however, both on uplands and lower levels is under terraces given to paddy and here the soil cover is relatively thick being fertile and more clayey than the eroded soils of unterraced uplands.

The landscape over a wide area is rural. The major crop of the farmers is rice, which is favored by the monsoon climate. The cultivable land falls into two classes, the terraced lowlands on which rice is the most important crop and the uplands which produce coarse rice, millet, pulses and oil seeds. The most valuable are the lower terraces which remain continually wet and where double cropping is possible. The middle terraces are second in value and the highest terraces are of least value. The farmer there is entirely dependent on a good rainfall for his crop. If the monsoon ceases in the latter half of August or early September the rice crop on the highest terraces perishes and the cultivators are unable to get a

good crop of rice, pulse, or oil seeds. The upland crops are usually sown in rotation. Market gardening has become important in some areas.

The road system (Fig. 6) over the Ranchi Plateau has helped very much in the development of agriculture and extension of the cultivable area. Further, the roads have also helped in the exploitation of the forest resources of the plateau. Timber is now transported on trucks and there is a lac factory at Ranchi based on the raw lac collected from the forests. A century ago, the only means of communication in the region consisted of jungle paths over which no wheeled vehicle could pass. At present the plateau has a network of trunk and feeder roads, and there is also a railway traversing the plateau from east to west. The development of roads and the railway has changed much of the landscape of the region in certain areas.

10. *The Hazaribagh Plateau*

The Hazaribagh Plateau consists of two different tablelands. The southern or higher plateau with an average elevation of 2000 feet extends from the Damodar Valley in the south to a marked edge in the north. The lower plateau occupies the northern and eastern portions and has an average elevation of about 1300 feet. The region is drained towards the north mainly by the Lilajan and Mohani, and towards the south and southeast by the Damodar and its tributaries.

Agriculture is the main activity. In common with the highlands of Chota Nagpur the cultivated land is classified into (a) *don* or *dhanket*, i.e., wet terraced rice lands, and (b) *tanr*, i.e., uplands devoted to dry crops. Nearly 40 per cent of the cultivated area forms the *don* lands given to wet cultivation and the rest forms the *tanr* lands given to dry cultivation. The main crop, in Hazaribagh, is rice, grown on the terraced lowlands. The next most important crop is maize which is grown on the uplands. Other crops are millets, pulses, and oil seeds which are also cultivated on the *tanr* lands.

A large part of the plateau has been rendered unproductive by soil erosion. Gullies of various types leading to ravines, chasms, etc., disfigure the plateau, especially in between the *don* and *tanr* lands. Wherever the sloping land is not properly terraced into flat fields with proper embankments sheet erosion has progressed.

Next to agriculture, the exploitation of the forests is the most important activity. The hills and scarps of the plateau are covered with deciduous trees. The principal tree yielding good timber is *sakhua* or *sal* (*Shorea robusta*).

Since the development of roads and the railway, there has been a marked increase in the cultivated area and also in the exploitation of forests. The main market centers of the region, viz., Chatra, Simaria, Tandwa, and Gidhaur, are connected with Hazaribagh by good roads.

11. *The Western Higher Plateau*

The higher plateau to the west of Lohardaga, occupying parts of the Ranchi and Hazaribagh Districts, forms a distinct economic region. This is comparatively one of the least developed regions of Chota Nagpur. The chief economic activity is the exploitation of the forest resources which are of considerable value. Mining of bauxite and agriculture have developed to a limited extent in some parts of the region.

The chief factor responsible for the comparative isolation and backward economy of the region is the inaccessibility of the area. The whole region is cut off from the Ranchi and Palamau

Districts by a line of forest-covered steep hills which present difficulties for the development of a transport system. There is only one metalled road in the region up to Netarhat.

The lofty, flat topped hills known as "*pats*" are covered with deciduous forests. The *sal* (*Shorea robusta*) is the most plentiful tree. After cutting, timber is transported from the forest by means of motor trucks on the unmetalled hill roads which are not motorable during the rainy season. Timber is sent mainly to the market at Daltonganj, a distance of about 40 miles.

The region contains deposits of bauxite, the mining of which has been recently developed at Bagru. The Lohardaga-Purulia branch of the Bengal Nagpur Railway has given a real fillip to the development of bauxite deposits of the area.

Due to the poor, gravelly nature of the soil, cultivation is restricted to only a few favored areas. The region as a whole is very sparsely populated.

12. *The Palamau hilly region*

The Palamau hilly region, lying in Palamau District, is covered for the most part with low forests. The hills have the average elevation of 1200 feet and they consist of a series of peaks and ranges with a general east-west trend.

The main activity in this region is the exploitation of the forest resources. The relief and the shallowness of the soil are the limiting factors to the development of agriculture. The *sal* (*Shorea robusta*) is the principal tree found in the forests, and usually occupies the lower slopes of the highlands. The forests play a great role in the economy of the highlands, and the yield from the forest forms the chief export. Among the important forest products are timber and lac. The manufacture of cutch (*kath*) from the *Khair* (*Acacia catechu*) tree is also important.

The roads have greatly helped in shaping the economy of the area. The exploitation of the forests on a large scale started after the construction of the roads and railways. Timber is transported by carts and automobiles to the nearest railway station on the East Indian Railway and then on by rail to its markets. The main market centers of Garwa, Ranka, Satbarwa, and Leslieganj have facilities of transport by roads which connect them with the railway.

13. *The North Koel Basin*

The North Koel Basin contains fertile alluvial soil, covered with crops of rice and, to a less extent, wheat, barley, and sugar cane. Unfortunately, the rainfall is frequently either deficient or unfavorably distributed, and the agricultural prosperity depends on irrigation. The cultivation of rice is largely dependent on small *bandhs* or reservoirs (also called *ahars*), of which an enormous number have been constructed all over the country, in almost every depression. These *bandhs*, for the storage of water, are made by throwing up embankments across drainage hollows or across the natural slope of the fields, so as to intercept and impound the surface drainage. The water is utilized in August, when transplanting is in full swing, or at the close of the monsoon, when a supply of water is vitally necessary to bring the rice plants to maturity. After the irrigation of the paddy is over, the water, if any, left in the *bandh* is drained off, and the bed of the reservoir is cultivated with wheat, barley, and other cold weather crops.

The crops grown in the basin are divided into three great divisions: the *aghani*, *bhadoi*, and *rabi* crops. The *aghani* is the winter crop consisting of

sugar cane and rice, which is harvested in the month of *Aghan* (November-December); the *bhadoi* is the autumn crop, maize and millets, reaped in the month of *Bhado* (August-September); while the *rabi* crop consisting of gram, wheat, barley, and pulses is harvested in the spring. The *aghani* crops are the most important, and occupy nearly 60 per cent of the net cropped area.

The region is well served by transport facilities. The railway running along the valley of the North Koel River has helped much towards the prosperity of the basin. Important roads also follow the valley of the North Koel and serve as trade routes of considerable value. Most of the produce flow along these roads.

14. *The Santal Parganas Highlands*

The Santal Parganas Highlands region, comprising the western and southwestern parts of the Santal Parganas District, is an upland tract consisting of long spurs with alternating valleys. Agriculture is the dominant activity of the region.

The valleys that lie between the undulating ridges are full of fertile soil and are chiefly used for growing rice. The crests of the ridges, however, are very poor, being made up of gravel or stiff clay lying on a hard subsoil. The slopes of these ridges have good soil, and rice is cultivated by cutting level terraces. The ridge slopes thus present the appearance of a series of steps, varying from one to five feet in height. Irrigation is essential for successful cultivation of rice, and nearly one-third of the rice land is protected from drought by small irrigation works. The irrigation works generally take the form of embankments constructed across ravines, hollows or other natural depressions which impound the drainage water. They thus form reservoirs, from which the rice fields, stretching away, each on a lower level than another, are irrigated.

Rice is the chief crop. It is grown mostly in the valleys and terraced slopes and accounts for about half of the total cropped area. The next important crop is maize. Wheat, barley, linseed, and gram are grown on the uplands.

Within the last 50 years there has been great development of road transport in the region, which has led to the growth of settlements. Large areas have been reclaimed by the settlers, and the cultivated area has increased very much in that time. Dumka, Godda, Deogarh, and Jamtara are the chief trade centers of the region.

15. *The Rajmahal hills region*

The region roughly corresponding to the Rajmahal traps and Gondwanas constitutes a definite structural and physical unit. The Rajmahal hills stretch in a southwest to northeast direction roughly from the Mor Valley to the Ganga in the north. The region consists mainly of a series of hills and small plateaus intersected at comparatively short intervals by a number of transverse river valleys. The general elevation of the area varies from 500 to 800 feet.

Economically, this is an undeveloped region. It is inhabited by the Santals and other primitive tribes. The hills are thickly forested. At places Sabai grass (*Ischaemum angustifolium*) is found growing wild on the hills. From those parts of the hills which are accessible the Sabai grass is cut and dispatched by rail to the paper mills at Calcutta, where it is used as raw material for the manufacture of paper.

The more or less level stretches of the Rajmahal hills contain patches of soil suitable for agriculture. The gentle slopes and the hilltops have been

cultivated by the aborigines living in these remote hills. The chief crops grown are rice, millet, and pulses.

The region is still inaccessible to the modern means of communication and pack animals are the main beasts of burden. To the north the Rajmahal hills abut upon the Ganga, leaving only a narrow passage along which the East Indian Railway passes.

16. *The eastern Manbhum region*

The basin of the Kasai and its tributaries in eastern Manbhum District represents an intermediate zone between the plains of West Bengal and the tableland of Chota Nagpur. Towards the west, the region is studded with spurs projecting from the highlands of Chota Nagpur; these gradually fade in the east and the area becomes more level.

In the western part of the region the ridge slopes have been terraced, and the eye meets with the view of large expanse of terraced rice fields dotted with numerous small tanks and here and there clumps of trees marking the village sites. In the eastern portion, the topography is level and terracing is barely noticeable. Towards the east, in extensive level areas of the Manbhum Plain, there are vast stretches of bunded paddy fields, resembling the landscape of the Ganga Valley except for a few granitic domes.

Rice, which occupies no less than 70 per cent of the cultivated area, is undoubtedly the most important crop of the area. Next in importance to rice as a food crop is maize. This crop is cultivated by the poor cultivators for home consumption. Of non-food crops, oil seeds, grown both as a winter and as a spring crop, are the most important.

A number of good roads intersect the region, and they have greatly added to the economic prosperity of the Kasai Plain. The main market centers of Manbazar and Barabazar have good transport facilities.

17. *The Baghmundi and Dalma range*

Geographically, the Baghmundi range and the Dalma range form a well-defined unit. The Baghmundi range is a plateau of considerable extent on which there are a number of flourishing villages. This range is connected through numerous isolated peaks and groups of low hills with the Dalma range. The whole area forms the watershed between the Subarnarekha and its tributaries and the Kasai and its affluents.

Agriculture and the exploitation of forests are the chief activities in this area. Rice is the main crop on the Baghmundi Plateau. South of the Baghmundi Plateau cultivation becomes fairly close northeast of Chandil. But as the Dalma hills are approached, cultivation becomes scattered giving way as one advances to scrub jungle, and when the foothills are approached to forest.

The Baghmundi and the Dalma range are completely clothed with dense forests. The only means of communication for exploiting the forest resources is the bullock cart with solid wooden wheels which can negotiate the hilly forest tracks. This region is comparatively undeveloped and has poor transport facilities.

18. *The Kharkai-Subarnarekha Plain*

The headstreams which unite to form the Subarnarekha rise on the Ranchi Plateau. The river flows through a widening and descending valley till it tumbles down from the plateau edge by the falls of the Hundrugagh. From here it turns southwards. In Singhbhum District it bends towards the southeast and possesses a broad and comparatively level valley. The right

bank tributaries of the Subarnarekha include the Kharkai River which has a broad level valley. The last river along with its tributary, the Sanjai, flows through a broad plain surrounded on all sides by hill-ranges. This plain merges with the Subarnarekha Valley near Jamshedpur and forms a distinct agricultural region.

For agricultural purposes, the area may be divided into: first, the comparatively level plains embanked for rice cultivation; second, the open valleys with low alternating hills which have been carefully levelled and grow rice. The lands at the bottom of valleys and depressions (*Bera* lands) are the richest of all the lands, yielding good crops of rice, followed occasionally by oil seeds, barley, or pulses. The lands higher up the slope (called *Bad*) grow early rice, cereals, pulses, and other crops. The uplands or tops of the ridges, which are composed of light soil, are known as *gora*. The *gora* lands in the vicinity of the homesteads are usually sown with millets and pulses. The *gora* land farther from the village is not tilled and is rather barren.

This region has good transport facilities. The roads serve as local trade routes and connect the important trade centers of the area. With the improvement of transport facilities and subsequent settlement of this part of Singhbhum District, there has been considerable extension of the area under cultivation during the last few decades.

19. *Jhalda lac and shellac region*

The Jhalda region includes the hilly and forested parts of western Manbhum and the adjoining areas of Ranchi and Hazaribagh Districts. The area produces raw lac from which shellac is manufactured. The production of raw lac is related to certain trees which grow abundantly in the forests of Chota Nagpur highlands. The raw lac is a resinous incrustation produced around the bodies of colonies of the lac insect after it has fastened on the twigs of various trees, of which the most important as lac producers are the *kusum* (*Schleichera trijuga*), the *palās* (*Butea frondosa*) and the *bair* (*Zizyphus jujuba*). The trees on which lac insect grows are called its host.

The lac areas of Chota Nagpur cover extensive lands in Hazaribagh, Manbhum, Palamau, Ranchi and Singhbhum Districts. The most important area, however, is in Manbhum District around Jhalda and Balrampur. This region is responsible for nearly 40 per cent of the total lac production. The lac is grown mostly on lands below 1000 feet in elevation. The whole lac region has rainfall ranging from 50 to a little over 60 inches. Hail and frost, strong, dry and hot winds, which may cause serious loss at the time of swarming and fixation of the lac insect, are uncommon in the area.

There are two main processes in the cultivation of lac: (1) infection of the lac insect to the host-tree, and (2) harvesting, which consists of cutting and collecting the twigs and branches of the host on which encrustations of lac have been formed. After harvesting, the lac encrustations from the twigs are removed either by hand or by knives or sickles, which yields stick lac. There are four lac crops in a year (1) *Baisakhi* (harvested in April–July), (2) *Katki* (harvested in October–November), (3) *Jethua* (harvested in June–July), (4) *Aghani* (harvested in November–February). The *baisakhi* harvest is the biggest and most important.

For the manufacture of shellac, seed lac is first made from the stick lac, which is later melted and yields shellac. The melting of seed lac is done in *bhattas* (fireplace). The shellac manu-

facture in the area is mainly a small scale industry. The total number of all shellac factories in Manbhum District was estimated, in 1943, to be 111, with a total number of 1339 *bhattas*. The most important manufacturing centers are Jhalda, Purulia, and Balrampur. These shellac manufacturing centers besides being located in the largest lac producing area receive considerable amounts of stick lac from the adjoining districts of Hazaribagh, Ranchi, and Singhbhum. Jhalda is noted for its large scale shellac factories, containing as many as 10 out of the 17 registered lac factories in 1941. Jhalda is situated close to the meeting point of the Hazaribagh, Ranchi, and Manbhum Districts and is connected by means of the Bengal Nagpur Railway with important lac producing centers of the Chota Nagpur Plateau and Calcutta. The Damodar Valley coal fields are also close to it and connected by rail. Balrampur, situated 14 miles southeast of Jhalda, is the biggest cottage industry center. It is nearer to the lac producing areas of Kolhan, Saraikella, and Kharsawan and thus has an advantageous location.

CONCLUSION

Upon the old simple pattern of rural landscape of Chota Nagpur has been superimposed a striking modern cultural landscape expressed in the chimneys and headframes of collieries, blast furnaces and coke ovens, pit heaps, quarries, modern factories, engineering works, railroads, and sprawling towns. These new features of the geographical landscape, resulting from mining and industrial developments, have modified and are continually changing the face of Chota Nagpur Plateau. The development of coal mining in Damodar Valley, iron mining in Kolhan, copper mining in eastern Singhbhum, mica mining in Hazaribagh, and quarrying of bauxite in Ranchi have wrought profound changes upon the use of agricultural land in the surrounding regions. Likewise the development of heavy steel industries at Jamshedpur, copper smelting industry in the Mushabani-Ghatshila area, and the varied industrial developments (coke manufacture and by-products works, fire-clay and silica works, refractory and ceramics industries, engineering and foundry works, and the giant fertilizer factory at Sindri) in the Damodar Valley have had their impact and effects upon the economy, land use, and population of the immediate environment. No longer are the hitherto hilly and forested areas around the mines and factories waste and uncultivated. They have been utilized for market gardening and crop production. Not only has there been a considerable increase in the agricultural area of Chota Nagpur, but the character of farming has also changed. Most of the crops and farm produce are now raised for the nearby mining and industrial centers.

The development of mining and industrial centers has not only modified the physical landscape but also the old pattern of settlement and human occupation. The labor force of the mining and industrial centers is drawn from the countryside and some come from much farther away. In this way there has been a shifting of population from rural areas to urban centers and a consequent decrease in the pressure of population on land. New settlements have sprung up, and rank as important regional trade centers. Jamshedpur, Mushabani, Gua, Kodarma, Ramgarh, Jharia, Dhanbad, and Dalmianagar are a few examples of such new urban settlements. One of the effects of the development of modern landscapes is seen in the decline in importance of the old trade centers on the roads like Chatra, Gumla, Gola, Hunterganj, etc., and the rise in

importance of new trade centers near the railways like Dhanbad, Chakradharpur, Purulia, Jhalda, Chandil, and Lohardaga. The development of railways has, further, changed the trade hinterland of many centers.

Finally, it is important to emphasize the complimentary character of the mineral and industrial regions described above. Transport is welding all these mineral and industrial regions of Chota Nagpur into one major industrial region of India. If the development of the entire area is well planned and efficiently carried out, this will produce an industrial region of world importance.

POSTSCRIPT

Since the foregoing article was written (early 1952) there has been impressive development and urbanization, and much more has been planned. Among the significant schemes recently completed are the Tiliaya Dam and hydroelectric power plant, and the Bokaro thermal power station units of the multi-purpose Damodar Valley Project. The Tiliaya Dam, on the Barakar, will provide irrigation water, and the hydroelectric station will supply power to the extensive mica mines. The giant thermal power plant at Bokaro, generating electricity from the nearby low-grade coal deposits, will provide cheap power to the iron and steel industry, copper industry, cement industry, and the rapidly springing engineering and basic industries in Chota Nagpur. Synchronizing with these developments is the rise of various urban settlements in the former forest-covered areas of the plateau. Another significant development is the integration, in April 1952, of the two railway systems (East Indian and Bengal Nagpur) formerly serving Chota Nagpur into one unified system, the Eastern Railway, which also links the neighboring industrial region of West Bengal, and the mining areas of Orissa and eastern Madhya Pradesh.

Under the first Five Year Plan, now carried out, an all-round and unified scheme of agricultural, mineral, and industrial development has been envisaged. The Plan gives topmost priority to agricultural planning and rural development, lays down a rational policy of development and utilization of coal, iron ore, mica, and bauxite resources, and provides for expansion of the existing large industrial units and the establishment of certain new basic industries in Chota Nagpur. These development projects, if successfully carried out, will certainly make Chota Nagpur a major industrial district of the world.

Note: The following Quarter Inch Map (scale 1:253,440) sheets published by the Survey of India, on which nearly all place names mentioned in the article can be found, may be consulted:

Nos. 73 A; 73 B; 73 E; 73 F; 73 I; 73 J; 72 D; 72 H; 72 L; 72 O; 72 P; 63 P.

The Government of India revised certain names effective after August 15, 1947. The revised names used in this paper are the Ganga for the Ganges, Kanpur for Cawnpore, Uttar Pradesh for the United Provinces, and Madhya Pradesh for the old Central Province. Santal Parganas is also written as Santhal Parganas.

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URUGUAY'S AGRICULTURAL PROBLEMS

Russell H. Fitzgibbon

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URUGUAY is a democratic country, its people will stoutly maintain—it has freedom of speech, it respects civil liberties, it has an excellent voting record. But yet, it has two tyrants. They dominate, directly or indirectly, virtually all Uruguayan activity. Politics is to a considerable degree a product of their rule. The social landscape is largely conditioned by their continuance in Uruguay. They live in the country, but Montevideo, the capital city, is much at their mercy. Their names are Cattle and Sheep.

Travel almost anywhere over the Uruguayan countryside and sheep and cattle are in evidence. Journey back into Uruguayan history for three centuries and more and cattle and sheep, especially the former, are the pillars of the economy. Of hogs, goats, oxen, burros, there are few; hogs, for example, number only about 250,000. Of horses there are about half a million, but they are, by and large, simply an adjunct of the livestock industry. Uruguay has, for better or worse, an essentially monoculture economy. If sheep and cattle could vote, the human population of Uruguay would be hopelessly outnumbered in determining the country's destiny. For every man, woman, and child in Uruguay there are more than three cattle and more than nine sheep. The Department of Montevideo, almost exclusively urban, counted in 1951 only 11,094 cattle and no sheep; that of Tacuarembó in the north, 790,174 cattle and 2,297,802 sheep.

Natural Conditions

Natural conditions have been good to Uruguayan livestock. Native pasture is normally excellent. The rainfall, though irregular, averages from 39 to 41 inches annually. Temperatures in humid, subtropical Uruguay are almost always moderate; they usually range from 50° to 72° (Fahrenheit), and the lowest and highest ever recorded are 23° and 109.5°. Frosts are infrequent and light. Wild animals that might claim a toll of livestock have been very few indeed.

Soils in most parts of the country are adequate, but the almost bottomless depths of soil in parts of the Argentine pampas are not found in Uruguay; rock outcroppings in the latter country are much more common. The thinner soils necessarily have an important bearing on the cultivation of crops but they are less important from the standpoint of grazing.

The physical and economic cards are stacked in favor of a livestock industry and against cropping. More than 90 per cent of Uruguay's area is agriculturally utilizable; less than 10 per cent of it is in crops (Table II). Of the total value of Uruguay's exports in 1950 agricultural products represented 97 per cent, worth 317,400,000 pesos. Of that sum, the value of the first three exports, all from the livestock industry,

FIG. 1.

were as follows: wool, 177,900,000 pesos; meat and its derivatives, 61,000,000 pesos; and hides and skins, 41,900,000 pesos. The total value of all agricultural produce (including livestock and wool) in 1951 was estimated at 588,000,000 pesos. The tyranny of cattle and sheep is a prosperity-producing one, despite the fact that a preliminary estimate of the value of agricultural produce for 1952 dropped the figure about a hundred million pesos below that for 1951. It is by no accident or coincidence that the cabinet post having to do with the rural economy is not Agriculture and Livestock but rather Livestock and Agriculture (*Ganadería y Agricultura*).

Livestock—cattle, horses, sheep—were turned loose in the Banda Oriental, or colonial Uruguay, by the Spanish during the seventeenth century. They throve fabulously. Colonial Uruguay was well characterized as the Age of

TABLE I

SHEEP AND CATTLE POPULATION OF URUGUAY FOR SELECTED YEARS

Year	*Sheep*	*Cattle*
1852	796,289	1,888,622
1860	1,989,929	3,632,203
1900	18,608,717	6,827,428
1908	26,286,296	8,192,602
1916	11,472,852	7,802,442
1924	14,443,341	8,431,613
1930	20,558,124	7,127,912
1937	17,931,327	8,296,890
1943	20,288,756	6,255,976
1946	19,559,325	6,883,811
1951	23,408,648	8,154,609

Leather. Leather made much of the clothing, some of the furniture, and occasionally a part of a dwelling. Cattle skulls were used as seats. Cow dung served as fuel. The free-ranging gaucho was not merely the principal human cog in the Uruguayan economic mechanism for decades and generations—he was romanticized in song and story and gave rise to a whole literary genre. He was related to the *vaquero* of southern Brazil, the *sertanejo* of the Brazilian hinterland, the *llanero* of Venezuela, even to the cowboy of the western plains of the United States. The gaucho had nothing but contempt for the city.

Early cattle skinners usually made camp along some Uruguayan stream where they established themselves for some three or four months in the late fall and winter. The camps were "staying places," and hence the people of Uruguay and other Platine regions called them *estancias*, from *estar* "to be (located or situated)." The "*estancia*" later gained a different connotation, but the cattle industry thus contributed at an early day to the language. The gauchos would hamstring, kill, and skin all the available cattle in the vicinity and then move on to another location. By the middle of the eighteenth century most of Uruguay was under some sort of vague individual land claims. *Estancias*—estates, as the word had by then come to mean—were huge, of areas up to 250,000 acres.

This general picture of rural Uruguay continued essentially unchanged until the second half of the nineteenth century. Cattle were valued for their hides. Tallow and jerked meat—the *charqui* of the pampas or the jerky of the American Southwest, usually now called *tasajo*—were usable parts of the animal but distinctly secondary. The jerked meat formed an interesting part of early international trade. It was sold in reasonably large quantities for consumption by slaves on the Brazilian and Caribbean sugar plantations. The opening of the Liebig meat-extract plant at Fray Bentos in 1863–65 may be said to have marked the beginning of a modern period in the history of the Uruguayan cattle industry. Prior to that time the salting of beef had attained a small-scale importance because the tough, lean animals of the Uruguayan plains served eminently well as a source of meat for salting.

The fencing of the ranges (and the introduction of barbed-wire fence), the development of refrigeration ships for the European trade, the improvement

TABLE II

LAND USE IN URUGUAY, ACCORDING TO THE 1951 AGRICULTURAL CENSUS

Category	*Acreage*	
Productive Land		
Range grassland	34,497,845	
Cultivated land	3,024,184	
Land in fallow	565,262	
Planted pastures	1,168,270	
Natural woodland	966,689	
Planted woodland	233,082	
Vegetable gardens	147,716	
Orchards and vineyards	137,129	40,740,177
Other Land		
Sand dunes	61,646	
Rocky land	713,032	
Swamps	141,585	
Alkaline flats	21,860	
Lakes	58,411	
Roads, farmsteads, etc.	188,160	1,184,694
Total		41,924,871

of breeds and the introduction of new ones—all these developments went hand in hand to remake the picture of the cattle industry in Uruguay in the second half of the nineteenth and first half of the twentieth centuries.

The Uruguayan cattle industry is inevitably compared or contrasted, or both, with that in Argentina. In general, that in Argentina is in advance, both absolutely and relatively, of the Uruguayan industry. Argentine soils are deeper and richer with the result that grasses are better. Argentina has done more with stock breeding than has Uruguay. (And yet, a Hereford bull sold at the national livestock exposition at Montevideo on August 28, 1951, for a record price of 80,000 pesos or about $33,000). In some respects Argentine feeding practices have been better, especially in regard to the use of alfalfa. But Uruguay has, over a period of years, been second only as a beef-exporting country to the vastly larger Argentina.

In the latter part of the nineteenth century the *saladero* began to give way to the *frigorífico*. The former had salted the meat it processed; the *frigorífico* prepared chilled, frozen, and canned meats and hence demanded a better grade of beef. The development of the *frigorífico* meant the coming of big business to Uruguay. As the price of cattle increased the meat-extract industry declined in importance because it was geared to a low-priced source of supply.

England provided the first and, indeed, most of the breeding stock introduced into Uruguay. The first Shorthorns were imported in 1859, the original Herefords about 1884; at present fully fourth-fifths of Uruguayan cattle are principally Hereford. There are now 80,579 registered Herefords and 15,439 registered Shorthorns in the country. The introduction of zebu cattle is prohibited by law in order that a tropical breed, considered unadapted to Uruguay, will not become mixed with the established breeds. For many decades almost the whole emphasis in breeding was on beef cattle; no real dairy industry existed in Uruguay before about 1930 when considerable numbers of Holstein-Friesian cattle began to be imported from Argentina and the Netherlands.

LANDHOLDING

The nature and extent of the livestock industry necessarily determine the pattern of landholding. It is impossible to separate cattle-raising areas from those given over to sheep since in most parts of Uruguay cattle and sheep graze together—*estancieros* claim it is better for both. The lands of Uruguay can be classified in other ways, however. The Río Negro, flowing across Uruguay from northeast to southwest, is a stock-raising demarcation line of sorts. South of the river is found virtually all of the relatively small amount of cropped land. South of the Río Negro is the better grazing land for fattening cattle. To the north lie the tick-infested areas of Uruguay. To the north, also, are the bigger *estancias* and the better areas for breeding.

Although the era of the giant *estancia* has not entirely passed, Uruguay is not now to be considered as a nation of large farms. An agricultural census in 1951 showed 85,258 farm units. Almost three-fourths of them were holdings of under 250 acres each.[1] The three-fourths had less than one-tenth of the area of all farm units, however. The units of more than 12,500 acres were negligible in numbers but contained almost a fifth of the total area (Table

[1] The Uruguayan unit for agricultural area measurements is the hectare, which is here arbitrarily translated at 2.50 acres to preserve some degree of roundness.

TABLE III

SIZES OF FARM UNITS, URUGUAY, 1951

Size	*Number*	*Per cent of Number*	*Area*	*Per cent of Area*
Under 12.5 acres	10,953	13	71,939 acres	
12.5–25 "	11,117	13	189,350 "	2
25–50 "	13,771	16	476,441 "	
50–125 "	16,910	20	1,321,485 "	3
125–250 "	10,375	12	1,809,127 "	4
250–500 "	7,814	9	2,725,936 "	7
500–1,250 "	7,241	9	5,611,875 "	13
1,250–2,500 "	3,475	4	6,036,623 "	15
2,500–6,250 "	2,452	3	9,409,969 "	22
6,250–12,500 "	763	1	6,381,672 "	15
12,500–25,000 "	316		5,099,932 "	12
Over 25,000 "	71		2,790,522 "	7
Totals	85,258	100	41,924,871 acres	100

III). Perhaps a dozen individuals or family holdings run more than 100,000 acres in extent. The Martiricorena lands in the Department of Artigas, the Romay Salvo *estancias* in Río Negro, and the Damboriarena holdings in Rivera, some of them almost corporate in character, are classic examples of the lordly domains which used to be more characteristic of the pattern of land tenure. Allegedly 35 proprietors own more than half of the Department of Artigas.[2]

It would be difficult to make any exact correlation between the size and character of *estancias* in Uruguay. In general, however, the rural units where a diversified or mixed farming is carried on have heretofore tended to be somewhat smaller; they are located chiefly in the better soils in western and southern Uruguay, particularly near Montevideo. The *estancias* devoted more exclusively to grazing, larger in size, are located principally in the poorer soils of central, northern, and eastern Uruguay. The area available for stock raising and cropping will be increased if and when an ambitious flood-control and drainage project, involving more than 2200 square miles of land in the eastern Departments of Rocha and Treinta y Tres is completed.

Various causes contributed to a decline in the average size of land holdings. Two of major importance were the legal prohibition, adopted during the administration of President José Batlle y Ordóñez, on entailed estates and, second, the relative absence of the social pressures which have operated to maintain large *estancias* in Argentina as a matter of family pride.

The pendulum may now be swinging in the opposite direction, however. The long-range trend seems to be for holdings to become larger, especially in the mixed-farming areas where use of modern equipment and methods puts a premium on large-scale operations. This is statistically borne out by a comparison of the farm sizes reported in the 1951 agricultural census with those reported in the 1943 census. Thus, farms under 250 acres constituted 13 per cent of the area in 1943 but only 9 per cent in 1951; farms over 12,500 acres totaled 15 per cent of the area in 1943 but 19 per cent in 1951.

The pattern of land tenure in Uruguay is even yet rigid. It is one of the major points at which the socially and economically advanced program of the Uruguayan government, a program

[2] *El País* (Montevideo), Aug. 18, 1951, p. 3.

which has made the country's name a byword for intelligent progress, has lagged and stumbled. The 1951 agricultural census revealed that half of the 85,258 farm units were fully owned; this is probably a record. Tenant farming is especially prevalent in the mixed cropping and grazing areas northwest of Montevideo. Renters occupied 38 per cent of all farm units in 1937 but only 29 per cent in 1951. The increased ownership over 14 years is to be credited primarily to greater general prosperity.

THE TENANT

The position of the tenant depends upon his bargaining power vis-a-vis the landowner. If that does not exactly represent a bargain between a lion and a rabbit it still places the tenant at a decided disadvantage. The large degree of farm tenancy has come about through the peon climbing the agricultural ladder to the level of a *medianero* or tenant farmer but finding that there the ladder ends. The only legal guarantee made the sharecropper is that he have an initial contract for four years which can be renewed for a like period. In a typical situation the sharecropper is provided with *estancia* land from which the *estanciero* gets 30 per cent of the crop or livestock yield. The tenant must provide all the machinery or equipment he uses.

The result of this relative insecurity is that the tenant farmer tends to "mine" the soil, take the maximum return from it without improvements, and build the cheapest sort of housing. The advantage of the system, to the agricultural picture in general but especially to the *estanciero*, is that it provides a stabilized and adequate labor supply for the big operator.

Mechanization of the rural economy has proceeded, especially recently, about as far and as fast as is practicable. The number of tractors in use in the middle of 1950 was estimated at 9000, almost three times the number used four years earlier. Uruguay now has a more favorable situation with respect to the mechanization of agriculture than any other country in South America.

Even without mechanization the labor needs on the part of the large-scale operator, especially if he concentrates on grazing, are not great. On a typical large *estancia* of, say, 65,000 or 70,000 acres the owner will carry on operations in perhaps four geographic areas. Each will be under the supervision of a *capataz* or foreman over livestock. Each of the foremen will have the assistance of a *puestero* (call him a ranger) and from 15 to 20 peons or hired workers. Additional hands will be needed at sheep-shearing time. If there is much cropping undertaken—and many *estancieros* prefer a rude system of rotation that alternates grazing and cropping—the crop foreman will have from ten to a hundred workers, depending on the seasonal work load. This means an average, then, of only about two employees (of all levels) per thousand acres; even a large *estancia*, consequently, may have very few permanent residents. It is a significant footnote to the sparseness of rural population in most parts of Uruguay.

The *puestero* is a peon who has climbed one step up the occupational ladder. He lives almost continuously in the saddle and his responsibilities are to check the livestock, repair fences, brand cattle, and vaccinate both cattle and sheep. He is the nearest institutional descendant of the gaucho that Uruguay now possesses, but he has been fenced in, both literally and figuratively, to a degree that makes him but a pale reflection of the historic gaucho.

Cattle and sheep graze freely at all seasons of the year. Livestock gets

almost no alfalfa or concentrates of any sort because range feeding is usually found adequate. This dependence on Nature can come a serious cropper when the *estanciero* is shortchanged by rainfall. A drought in 1916 resulted in the death of 1,000,000 cattle and 15,000,000 sheep; other heavy livestock mortality occurred for the same reason in 1942–43 and 1949–50. There are other hazards. Foot-and-mouth disease is widely prevalent but not virulent; its chief effect is not to kill the cattle but to keep down their weight. A little, but not enough, has been done to manufacture vaccines for it. A top-flight international agricultural mission which made a thorough study of the Uruguayan rural economy in 1950 concluded that losses, in reduced weights and deaths, from foot-and-mouth disease, tick fever, brucellosis, tuberculosis, and other livestock diseases were needlessly high.

Despite the various difficulties confronting the cattle industry the slaughter has not shown enormous variations over about half a century. Since 1940 the slaughter has varied from high figures of 1,516,000 head in 1943 and an estimated 1,500,000 in 1952 to lows of 922,000 head in 1945 and 930,000 in 1947. When there is a variation in the slaughter it reflects weather conditions (especially droughts), diseases, international prices, a fluctuating practice of holding cattle off the market until they are as much as six years old, etc. The producers, except the small ones, generally sell their cattle at public auctions which become institutionalized social affairs of a sort. They are generally held in a community center and the neighborhood gathers to discuss business and politics and to eat the barbecued beef ribs and hard rolls (washed down with wine) which the *estanciero* has provided.

CONSUMPTION HABITS

Who eats Uruguay's meat? In general, the country exports one-third and eats two-thirds of the roughly 190,000 tons of dressed meat it annually produces. Most of the exportable surplus of meat is sold under contract, much of it over a period of years to Great Britain; the United States has become an increasingly heavy purchaser since World War II. Montevideanos are heavy beef consumers. They have been estimated to eat more than a pound daily per capita and the annual needs of the city total about 450,000 head of cattle. Meat eating in Montevideo thrives under governmentally fixed and relatively low prices. A period of inflation, when unfixed food prices are skyrocketing, simply turns the people more strongly toward a meat diet. The cattle slaughter in 1951 dropped off somewhat, however, with the result that Montevideo experienced some shortage of beef, which in turn caused minor black market operations on the city's outskirts.

The inhabitants of the capital will eat mutton when they can't get beef. The meat diet in the interior, on the other hand, runs more strongly to mutton; some *estancia* workers, it has been stated on excellent authority, actually eat the fantastic average of four pounds of meat daily. Few cattle are killed to be eaten on the *estancias* because the meat of the larger animal would spoil before being consumed and because the cattle are more expensive than the sheep; beef is generally reserved for feast days. But beef consumption is increasing, both in Montevideo and the *campo*.

A systematically fostered Uruguayan dairy industry is less than a quarter of a century old. It now is based on about half a million head of dairy cattle,

almost 80 per cent of which are in the Montevideo milkshed extending for about 75 miles west, north, and east of the capital. Milk production per cow is low: it is estimated not to exceed about five quarts daily on an annual basis. The dairy cow can't take the hard life sometimes facing her beef-producing cousin. Summer droughts and rainy winters at times pose a problem. Financial losses from foot-and-mouth disease are relatively much higher for dairy than for beef cattle. Still, the consuming tastes of the Montevideo public have been educated to include more and more milk. Consumption more than doubled, within a dozen years, from roughly 16,000,000 gallons in 1936–37 to about 38,000,000 in 1948–49. A part of the explanation lies in the low fixed prices for milk and related dairy products. The government's double-barreled milk-pricing program—subsidies both to producer and consumer—meant a net loss to the government of about five cents a gallon.

The monopoly distribution agent in Montevideo is Conaprole (*Cooperativo Nacional de Productores de Leche*), which is not organized as a true cooperative but operates under an industrial privilege granted by the government. People in the interior buy milk in bulk from horse-drawn carts; how many germs they get with it is probably a matter of entire unconcern. For that matter, the international mission sponsored by the United Nations' Food and Agricultural Organization and the International Bank concluded that the average milk received by Conaprole for Montevideo distribution had a regrettably low quality.

Sheep Raising

For two centuries wool has been one of Uruguay's most important products. Sheep could be a tyrant in the colonial period as well as more recently. The first of them were introduced, about 1670, from Spain. The Spanish sometimes liked to do things the hard way: to bring the sheep to Uruguay they drove them over the Andes from Peru. Wool has always been the main concern of the sheep-raising industry; even now the production of commercially sold lamb and mutton is only of minor importance. Most Uruguayan wool is of a fine grade; little carpet wool is ordinarily produced. The most popular breed of sheep is the Corriedale. Rapid progress has been made, especially in recent decades, in improving breeds of sheep although breeding to improve wool quality began as early as 1851.

Sheep, like cattle, get a more or less cavalier treatment on Uruguayan *estancias*. They graze freely, they get no concentrated feeds, they have no sheepherders. A concession to science is made by dipping and deworming them. Beginning in October the fleecy gold begins to come in to the *estanciero* in the form of the annual wool clip, removed by power shearing. The approximately 70,000 to 85,000 long tons of wool available each year will usually have a minimum value of about 90,000,000 pesos or, say, about $36,000,000, depending, of course, on the rate of exchange. This means that sheep are annually worth more than fourteen dollars to every man, woman, and child in Uruguay. Wool prices began to skyrocket in the second half of 1950, probably due principally to the Korean War, and the average price for that year was almost three times the price level of a decade earlier; prices dropped sharply in 1951, however. Wool serves Uruguay well in the international markets because it is durable for shipment and, having high value in proportion to weight, easily pays its freight rates.

Economic Cassandras would have us believe that the development of orlon and other synthetic fibers may well spell the doom of the Uruguayan wool industry. They point to the blows earlier given by rayon and nylon to natural fibers. Those who know the wool industry in Uruguay and Argentina profess not to be alarmed, however. There may be an ultimate competition which will force prices down, to the advantage of the consumer, but growing populations and growing demands for wool for mixed-fiber textiles will make the industry indefinitely a pillar of the Uruguayan economy.

Cattle and sheep still remain enthroned, then, in Uruguay. That country has more of those animals per land area than any other in all of Latin America. Production costs are low and quality is comparatively high. Ranges are often overstocked, it is true. The foreign experts who studied Uruguay's rural economy in 1950 made some fundamental and broad recommendations for improvement but, basically, Uruguay's livestock industry appears as sound as its democracy.

AGRICULTURAL CROPS

The raising of crops offers other problems. Crop production has in general been primarily for domestic consumption and has kept pace with the increasing population. There is no evidence of population pressure on the land and malnutrition is never a national problem. In a situation like that of Japan, where population pressure requires the land to be intensively cultivated to feed the people, the problem is of one sort. Uruguay really presents the reverse of that: how to utilize ample land in the most effective way to get satisfactory returns. This fundamentally involves the pattern of population distribution.

Population is concentrated in the south of Uruguay. This has meant that crop raising, agriculture in a narrow or literal sense, has, almost perforce, been confined largely to the southern departments despite the occasional tendency of some *estancieros* to alternate grazing with cropping. Crop raising in Uruguay faces certain difficulties. The often thin soils are less suitable for crops than for pasturing. Soil nutrients, especially calcium and phosphates, are frequently depleted, and good techniques of farm management, including scientific and extensive fertilizing, are not widely enough practiced. Scientific soil conservation studies are less than a decade old in Uruguay and it has been estimated that three-fourths of the crop land needs such attention; even on natural grasslands considerable gullying and erosion exists because of overgrazing. Insect pests affect the crops, especially because there are virtually no winter freezes to keep such pests under partial control. A more serious difficulty is the erratic and unpredictable rainfall.

Crop raising is, then, somewhat of a gamble. The area in crops usually averages less than 5900 square miles, which is barely more than 8 per cent of the country's total area. The area in a specific crop will vary greatly from one year to another, however, depending on the fluctuation in rainfall, the cost-price relationship, locust invasions, and other factors. Wheat, corn, and flax have been the chief crops. The acreage of the first of those has remained fairly constant; the other two have somewhat declined in area under cultivation. Uruguay now supplies all its own wheat needs from the approximately half a million acres sown annually and even exports small amounts.

It is a far and fortunate cry from the situation in 1946 when drought conditions forced Uruguay to try to buy Argentine wheat and the Perón government, wanting its pound of flesh, demanded payment in dollars. An emergency shipment from the United States relieved Uruguay from a tight situation but taught the importance of self-sufficiency. Flax production, about 100,000 long tons annually, is used for linseed oil rather than fiber.

Until recent years relatively little attention was paid to the introduction of improved seed varieties. The work of Uruguay's one agricultural experiment station, north of Colonia, is now beginning to change that picture.

Truck farming is almost entirely economically tributary to Montevideo. It shows a long-range tendency to increase. Unpredictable rains are causing truck farmers to drill deep wells for irrigation. Only seven-tenths of one per cent of all Uruguayan land in agricultural use is devoted to producing vegetables, fruits, and wine grapes, but this infinitesimal fraction of the land has usually been responsible for from 17 to 20 per cent of agricultural income. It has been estimated that as recently as 1949 the value of such products probably exceeded that of all slaughter animals sold. Government agencies have encouraged experimentation with sugar cane and rice culture in the northwestern departments. Sugar production increased from about 1500 long tons in 1947 to 5850 tons in 1950. The northwestern corner of the country also has a growing importance as a citrus area. The raising of sunflowers has recently increased in southern Uruguay. Despite the greater variety and importance of fruit and vegetable production Uruguay still has to import a number of such products and other foods: the ubiquitous yerba maté, coffee, bananas, cacao, sugar, and potatoes.

Uruguay has almost no indigenous forest. Only about three per cent of its area even now carries trees, and most of them, or their ancestors, have been hand planted. The chief species of this sort are eucalyptus and pines; in addition there are willows, acacias, and poplars. The principal uses of such trees as Uruguay has are for firewood, fenceposts, and windbreaks. Logs and lumber for construction purposes have to be imported principally from Brazil and Paraguay. Only in the approximately 42,000 acres of state-owned forests is any scientific arboriculture practiced. The government as yet has done nothing to carry out high-level, scientific recommendations for a large-scale afforestation policy.

AGRICULTURAL ORGANIZATIONS

Uruguay has two prominent organizations of livestock farmers, the Rural Federation and the Rural Association. Both are organizations of *estancieros*, of, by, and for the big operators. The Federation is the more politically minded of the two, and many of its members are congressmen or important officeholders in the executive branch of the government. The Federation frequently has a considerable influence on legislation and the government's agricultural policy; it has been especially concerned with policies affecting commercial agriculture and meat production and marketing. The Rural Association functions as an official registry body for blooded and pedigreed livestock; pedigree records have been kept since 1887.

A relatively insignificant but recently spectacular organization is the Federal League of Rural Action. Its members are largely business men and *estancieros* described as reactionary, and its chief

activity in 1951 was a series of daily radio broadcasts by one "Chicotazo" by which it sought, unsuccessfully, to influence wool prices and marketing policies.

Another small organization, and one with relatively little prestige and influence, is the Uruguayan Grange Confederation. It is composed of small farmers carrying on diversified operations, principally within about 125 miles of Montevideo. Its political concern is chiefly with governmental legislation and policies affecting production and marketing problems of the fruit, truck-crop, poultry, and egg producers. Another (and influential) organization is the National Commission of Rural Development, which represents the interests of many small farm granges and similar organizations.

An Uruguayan equivalent of the Four-H Clubs is the *Movimiento de Juventud Agraria* (Farm Youth Movement) which operates through the rural schools on a volunteer basis. It began only about 1946 but in order to encourage it the Uruguayan congress appropriated 50,000 pesos in July, 1950, for its support.

SUBSIDIES

In a country where governmental regulation is as common as it is in Uruguay it is not to be expected that the rural economy would be free from it, even though the government's orientation has been more toward urban problems. The recent tendency has been for the government to participate more rather than less in the farmer's affairs. Most regulative activity having to do with stock raising and agriculture has been in the area of prices: production and consumption subsidies. The subsidy program has been a flexible one and has been definitely used by the government as a major instrument of policy. Its main professed purpose has been to promote small and medium-sized farms and to encourage production of fruits and vegetables. Viewed from another angle, the objective has been to boost production beyond what the natural prices obtainable would promote or to provide consumers (usually in Montevideo) with staple commodities below the cost of production. After the near-disastrous experience with Argentine wheat in 1946 the government began subsidy of wheat production to achieve the now successful goal of self-sufficiency in that grain.

The whole subsidy program has been severely criticized by foreign experts as an artificial, unsound, and jerrybuilt structure. It is claimed that the net effect of the program is to distribute income (with the taxpayer footing the ultimate net bill) rather than to curtail costs or modernize the food-producing industry. Critics argue that the subsidy pattern establishes the philosophy that "the government owes the farmer a living," that it consequently lessens rural initiative, and that it contributes to inflation and increases the price of imported items. Subsidies, they say, are potentially dangerous on an economic basis but are politically expedient as an easy way of placating pressure groups (usually consumers). The economic dangers of the subsidy program were vividly illustrated in 1951 when subsidy obligations ran about 38,000,000 pesos more than the funds (chiefly from foreign exchange profits) available to pay them. The result was a necessary consideration late in 1951 and early in 1952 of a retrenchment in the program.

Admittedly, the program has been expensive: the Ministry of Finance estimated that total subsidy payments in 1950 were more than 60,000,000 pesos, including 25,000,000 for wheat,

20,000,000 for meat, and 11,000,000 for milk.

STOCK RAISING AND PROSPERITY

The rural economy has usually been profitable for Uruguay and has contributed substantially to giving it the second highest per capita income in Latin America, a figure that United Nations experts estimated in 1950 to be $331 per year.[3] The major part of the investment and of the profits, although not a proportionately large share of the latter, are, of course, in stock raising. The value of Uruguayan ranch land has been estimated at 1,200,000,000 pesos; of the country's cattle, 500,000,000 pesos; of the sheep, 200,000,000 pesos; and of the buildings, fences, and other improvements, 100,000,000 pesos. The industry can consequently be appraised at some 2,000,000,000 pesos or, say (depending on exchange rates), $800,000,000. It is a tidy sum in any man's language. *Estancieros* have usually earned at least 7.5 per cent on their invested capital; many in recent years have had a 10 per cent return or better.

Perhaps, then, we should relabel Cattle and Sheep. They have been good to Uruguay. They turn out to be less tyrants than benevolent despots.

[3] For purposes of comparison the figures for the other countries of the hemisphere were: United States, $1453; Canada, $870; Argentina, $346; Venezuela, $322; Cuba, $296; Chile, $188; Panama, $183; Colombia, $132; Costa Rica, $125; Mexico, $121; Brazil, $112; Peru, $100; El Salvador, $92; Nicaragua, $89; Paraguay, $84; Honduras, $83; Guatemala, $77; Dominican Republic, $75; Bolivia, $55; Ecuador, $40; Haiti, $40.

PERCENTAGE DOT MAPS

J. Ross Mackay

Associate Professor Mackay of the Department of Geology and Geography, University of British Columbia, contributed two previous articles on cartographic techniques to ECONOMIC GEOGRAPHY.

ALTHOUGH the percentage dot map in which each dot represents a percentage of the distribution is superior to the common dot map for some mapping purposes, it is so seldom utilized that few examples exist in geographic literature.[1] The purpose of this discussion is to point out several advantages of the percentage dot map and to suggest that this neglected technique might be used more extensively, particularly on economic maps to show distribution patterns.

An empirical study was made of the preferences of some two hundred college students with respect to common dot maps and percentage dot maps. As it was desired to obtain unprejudiced reactions on the two types of maps, no attempt was made to explain their respective advantages and disadvantages. This procedure doubtless favored the common dot map, for all the students were at least somewhat familiar with it whereas the percentage map was new to almost everyone. A slight majority of the students preferred the common dot map when they were tested for the first time. However, whenever a group of students had the opportunity to discover for themselves the advantages of percentage dot maps by constructing them, then a majority, and often a substantial majority, favored them over the common dot map.

The basic difference between the percentage dot map and the common or quantitative dot map is derived from the two distinct functions assigned to their dots. In the percentage dot map, each dot represents a *percentage* of the total value of the distribution. Therefore the map has a round number of dots, either 100 or some simple multiple of it. In the common or quantitative dot map, each dot represents a *quantity* of the total value of the distribution. For the sake of convenience the quantity represented by a dot is generally chosen as a round number so no particular significance is attached to the total number of dots on the map—indeed, both the total number of dots and the total value of the distribution are customarily omitted from the map legend.

ADVANTAGES OF PERCENTAGE DOT MAPS

(1) The percentage dot map is ideal for making arithmetic comparisons. Dots in one portion of a map may be compared with those in another portion, with the total number on the map, and with those in another map. Information on percentages, fractional distributions, and proportions are quickly obtainable. For example, if there were 1000 dots on a world population map, then three dots in Ceylon would indicate

[1] The word "percentage" is used in the present study for any small part of a number which is usually 100, or some simple multiple of it. The use of "per cent" suggests a total of only 100 dots. "One per mille" has been used by some authors where only 1000 dots were involved. Excellent examples of the use of percentage dot maps to show distribution patterns may be seen in: L. Dudley Stamp, "The Land of Britain, Its Use and Misuse" (London, 1948), pp. 102–107, Figs. 53–64.

that Ceylon had 0.3 per cent of the world's population.

(2) The percentage dot map is easily understood. The relationship between the individual dot and the total number of dots is made familiar through the decimal system. Its advantages for precise and rapid mental arithmetic are apparent to most map readers. The simple concept of the percentage dot is often of more significance to map readers than a quantitative dot value which is commonly beyond the realm of normal experience and comprehension, e.g., "one dot represents 500,000 chickens."

(3) Percentage dots can be used in conjunction with certain other symbols, particularly "percentage circles." This combination is ideal for mapping distribution data which vary greatly in concentration, such as in population maps with sparsely settled rural areas but dense urban areas. A percentage circle can represent a large denomination, such as 5 per cent, with a percentage dot representing a much smaller denomination, such as 0.1 per cent. A legend showing the two symbol types is largely self-explanatory, because the relationship between the percentage dot and circle is simple and straightforward.

(4) Percentage dot maps are excellent for comparing area relations. In a recent article on "The Regional Concept" Preston E. James makes a number of significant observations on area relations and the map as an analytic device. He discusses and defines relationships which may be either accordant or discordant. "Accordant relations are either coincident or correspondent. A coincidence occurs when two phenomena occupy exactly the same area on the earth; in such a case the boundaries outlining the areas occupied by the two phenomena are said to coincide. A correspondence occurs when there is a discernible similarity between the areas of occurrence of two phenomena. . . . Discordant relationships exist when the patterns of two phenomena are wholly incongruous."[2]

The only effective way to analyze accordant and discordant relationships is with the aid of maps. Although many types of map symbols may be employed for the purpose, few are more popular than dots. The relative suitability of common dots versus percentage dots for showing accordant relations may be illustrated by considering the construction and comparison of dot maps to show wheat acreage and wheat production for Canada in 1951, the figures being 26,000,000 acres and 562,000,000 bushels of wheat, respectively. In order to analyze the closest form of accordance which James refers to as coincidence, let us *assume* that the per acre production of wheat is uniform all over Canada. The patterns for wheat acreage and wheat production would then be identical and give a perfect coincidence.

If common dot maps were drawn of the acreage and production, the dots would be chosen to represent convenient round numbers. Reasonable choices for dots would be numbers such as 10,000 acres of wheat and 100,000 bushels of wheat. The wheat production map would then have 5620 dots or about 2.16 x the 2600 dots of the wheat acreage map. Mathematically, there would be a coincidence in the boundaries and distribution between the two maps, because there would be 2.16 dots on the wheat production map for every dot on the acreage map and they would be similarly placed. Visually, however, the appearance of the

[2] Preston E. James: "The Regional Concept," *Ann. Assn. Amer. Geogrs.*, Vol. 42, 1952, pp. 195–222. Quotation p. 216.

two maps would be somewhat dissimilar, because one map would have 2.16 x the number of dots of the other. The sparse areas would not look equally sparse nor the dense areas equally dense.[3] If the variation in the ratio of dot numbers were greater, such as 4 or 8 instead of only 2.16, the disparity in their appearance would be greatly heightened. Another factor which would contribute towards their difference in appearance would be coalescence of dots in the densest areas of the wheat production map. The foregoing analysis shows that a perfect coincidence in two phenomena—in this hypothetical case wheat production and acreage—may exist mathematically although it may not appear so to map readers.

The obvious way of eliminating the visual difference between the wheat acreage and production maps discussed above is to remove the cause by putting the same number of dots on both maps. However, this easy solution is nothing more than the acceptance of the principle of the percentage dot, for if the same number of dots are used on each map then each dot stands for the same percentage of the distribution. If percentage dot maps were drawn with the same percentage unit, such as 0.1 per cent, then the two sets of phenomena would coincide in every respect, even dot for dot.

"Geography seeks geometric precision; that is, it is concerned more than bordering fields of study with the exact measurement of areas and patterns . . ." states Preston E. James.[4] For geometric precision in area analysis, not only for the location of the boundaries of accordant and discordant phenomena, but also for the analysis of the distribution of the phenomena within those boundaries, the percentage dot map may often be preferable to the common dot map.

[3] J. Ross Mackay: "Dotting the Dot Map: An Analysis of Dot Size, Number, and Visual Tone Density," *Surveying and Mapping*, Vol. 9, 1949, pp. 3–10.

[4] Preston E. James, *op. cit.*, p. 215.

Disadvantage of the Percentage Dot Map

The obvious disadvantage of the percentage dot is that it will never represent a round number of the distribution, except by chance. The number will be awkward looking (e.g., 8519) and there is certainly some prejudice against the use of such numbers. Furthermore, it is more troublesome to total up absolute values of the distribution with percentage dots than with the round numbers of quantitative dots. However, the antipathy toward awkward dot values can be partly overcome by first emphasizing the percentage value of the dot in the map legend before giving its numerical value.

Summary and Conclusions

The essential difference between a percentage dot map and a common dot map arises from the function given to the dot, i.e., whether it represents a *percentage* of the total distribution or a convenient *quantity*. A completely prepared percentage dot map and legend should permit the map reader to determine easily:

(1) the percentage value of the dot
(2) the numerical value of the dot
(3) the total value of the distribution
(4) the total number of dots
(5) the distribution of the dots
(6) the percentage, fraction, and proportion of the distribution in one area compared to any other area and to the total distribution

Small dot denominations are generally preferable to large ones. It is surprising how empty a half-page dot map looks if it has only 100 dots. Such

maps will seldom be overcrowded even with 1000 dots.[5]

The percentage dot map is particularly applicable to analyzing accordant and discordant patterns. Its principles are easily understood. Percentage dots can be used with certain other symbols, such as percentage circles, to show distributional data which vary greatly in concentration. Tests have shown that many people, in some instances a majority, actually prefer the percentage dot map to the common dot map for most mapping purposes. Human reactions should, in the final analysis, be an important factor in determining the cartographer's choice of map symbols.

Percentage dot maps are dotted in the same way as common dot maps. Each dot is placed, so far as possible, in the center of gravity of the distribution which it represents.

[5] There are one thousand dots (one per mille) in the maps of Stamp, *op. cit.*, and in Keith Buchanan and N. Hurwitz: "The 'Coloured' Community in the Union of South Africa," *Geogr. Rev.*, Vol. 40, 1950, p. 401, Fig. 3.

PETROLEUM IN THE SOVIET UNION: AN APPRAISAL OF A RECENT GERMAN STUDY*

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PERHAPS at no other time in the history of the world have the magnitude of a nation's petroleum resources and the productivity of a nation's petroleum industry so dominated international policy discussions as do those of the Soviet Union today. And rightly so—experiences of two world wars have demonstrated that the future of a nation as a world power depends to a very large degree on its possession of, or accessibility to, large reserves of petroleum.

The current atmosphere of tension between East and West gives appraisal of the petroleum situation in the Soviet Union an uncommon timeliness. To assess the Soviet petroleum industry's success in rehabilitating war-damaged producing fields and refineries and in supplying growing domestic demands of manufacturing, agriculture, and commerce, as well as the Soviet war machine and its ancillary activities in Korea, is indeed a lofty purpose. It is also a huge task. Such assessment is made more difficult by lack of authentic information for many phases of the industry. No official statistics with absolute figures have been made public by the Soviet Union since 1938. The practice of reporting all production results in percentages of the production quotas set up within Five-Year Plans has prevailed since 1938.

Despite the difficulties imposed by the immensity of the task and the limitations of source material, Dr. Hassmann has attempted to correlate the various phases of the Soviet petroleum industry and project them against a background of world-wide political and economic conditions. In the preface he explains the necessity for "going beyond the narrow economic boundaries" to understand the entire Soviet petroleum situation. Soviet petroleum policy has been shaped, in large part, by the fact that on the southwest the Soviet Union is bordered by the Middle East, which contains over half of the world's petroleum reserves. "Only from the background of the entire general world economic and political situation can the pecularities and special significance of the Soviet petroleum industry be shown."

*Heinrich Hassman: "Erdol in der Sowjetunion." 176 pp.; maps, tables. Industrieverleg von Hernhaussen K.G., Hamburg, 1951. DM 5.80. 8 x 5½ inches.

General Elements of Soviet Industry

Dr. Hassmann has divided his thesis into four parts, which gives the book a very satisfactory arrangement. The first is a treatment of the general elements of Soviet industry, including geography, history, population, government, and economic theory. It concludes with a discussion of Soviet industrial accomplishments, in which the author lists, according to their geographic location, the following ten industrial regions:

1. The industrial region of the European northwest, with the main emphasis on Leningrad.

2. The central Russian industrial region, within a wide radius around Moscow, its natural gravitation point. It is based on the brown-coal mines in the Moscow Basin.

3. The south Russian industrial region in the Donets and Dnieper Basins, based upon the anthracite deposits of the Donets region and the iron-ore deposits of Krivoi Rog.

4. The industrial region of the middle Volga, extending from Kazan in the north to Stalingrad in the south. It contains important petroleum and natural gas deposits.

5. The industrial region of the Urals, the most important centers of which are Nishni Tagil, Sverdlovsk, Chelyabinsk, and Magnitogorsk with their rich ore and potash deposits.

6. The industrial region of the Caucasus between Novorossisk in the northwest and Baku in the southeast, where the important element is the rich petroleum deposits.

7. The Kuznetsk region, which lies between the cities of Novosibirsk, Barnaul, Stalinsk, and Tomsk and has important coal mines.

8. The industrial region on Lake Baikal, which owes its existence to coal deposits and has Irkutsk as its central point.

9. The industrial region of the Far East, which is situated astride the Amur River and has two important centers—Khabarovsk and Komsomolsk.

10. The Central Asiatic industrial region between Tashkent and Alma-Ata, important for its rich coal, iron, and petroleum deposits.

These ten regions are shown on a double-page map, along with the principal petroleum regions, natural gas fields, oil-shale deposits, and railroads. Following the regional divisions is a table reviewing Soviet industrial production as follows:

Year	*Coal*	*Pig Iron*	*Steel*	*Petroleum*	*Electricity, Billions of Kilowatt-hours*
	Millions of Tons				
1913	29	4.2	4.2	8.7	2.0
1938	133	14.6	18.0	28.2	39.4
1949	237	17.2	21.0	33.2	74.2
1950	261	19.5	27.0	37.6	90.0
1960 (Plan)	500	50.0	60.0	60.0	....

Development of the Petroleum Industry

The second part of the book begins with a résumé of the historical development of the Russian petroleum industry from 1860 to 1917.[1] Discussed are such topics as the relationship between the industry and the Czarist State, the various methods (rental, 1821–72; auction, 1872–96; and combined auction and tax system 1896–1917) by which individual operators could acquire drilling rights, the formation of the three

[1] Although the history of petroleum in Russia reaches far back into the realms of legend, such as reports of the Cloister "at the sign of eternal fire," which was situated in Surachany on the Apsheron Peninsula, petroleum production in the country was not important until the second half of the 19th century. Hassmann considers 1860 the beginning of the Russian petroleum industry.

major petroleum-industry groups that decisively influenced pre-World War I development of the Russian petroleum industry,[2] and the refining, transporting, domestic consumption, and exportation of Russian petroleum in Czarist times.

Fully two-thirds (33 pages) of Part II is devoted to the development of the country's petroleum industry under the Soviets. At present, control of the industry is vested in the Minister of the Petroleum Industry. The individual petroleum fields and installations are organized as trusts, and the trusts are brought together in larger associations. The trusts are subordinate to the associations, which, in turn, are subordinate to the Minister of the Petroleum Industry, who is responsible for all petroleum operations in the Soviet Union.

Under the Soviet regime geological surveys, which had been carried on even before World War I, were intensified in 1927, approximately coincidental with establishment of the First Five-Year Plan. The "Geological Committee," which had existed since 1882 but employed only 70 or 80 geologists before World War I, was reorganized in 1929 into the "Main Administration for Geology and Geodesy in the Supreme Council of the Political Economy of the U.S.S.R." In 1946 this organization became the Ministry of Geology. As a result of the planned co-operation of the State, industry, and science, 75 per cent of the entire area of the U.S.S.R. had been geologically explored by 1947.

In the field of geophysics Soviet scientists have readily adopted methods commonly used by the petroleum industry in the United States as soon as they recognized their practical value. Gravimetric, electric log, magnetometer, seismic, and geochemical methods are being used in the search for petroleum deposits. If there are weaknesses in Soviet petroleum technology, however, they are to be found in the field of drilling techniques, but improvement along these lines has been made. In the Baku region, for example, wells have been drilled deeper than 5000 meters, and a 4000-meter well has been drilled by one rig in one month, records that compare rather favorably with drilling achievements in the United States.

When the Soviet Government took over the petroleum industry, production had dropped to its lowest level since 1889. Under the New Economic Policy (NEP), which was announced by Lenin in 1922, petroleum production began an upward surge. Ten years after the October Revolution the country's production exceeded its output in 1900, when Russia was the world's leading petroleum producer.

Planned development of the Soviet petroleum industry coincided with the beginning of the State-planned economy. During the first Five-Year Plan (1928–32), no less than 1.6 billion rubles was invested in the petroleum industry, and production increased from 11.8 to 21.6 million tons. Under the Second Five-Year Plan (1933–37), 2.5 billion

[2] These three groups were the Nobel Combine, the Russian General Oil Corporation (R.G.O.C.), and the Royal Dutch-Shell. In 1875 the Nobel brothers, Robert and Ludwig, acquired the Balachany oil field near Baku and in 1879 founded the Naphtha Production Co. of the Nobel Bros. Considered the pioneers of the Russian petroleum industry, they laid the first Russian pipeline, which connected the Baku fields with Baku refineries, and placed in operation in 1877 the first Russian tanker, the "Zoroaster." The R.G.O.C. was formed in 1912 by Russian banking and industrial interests, with strong participation of English capital. In 1892 the Paris banking firm of Rothschild founded the Société Caspienne et de la Mer Noire, and in 1912 the majority of the company's stock was taken over by the Royal Dutch-Shell. Of Russia's total petroleum production in 1910–14, these groups controlled between 51 and 54 per cent. On June 1, 1918, the Council of the People's Commissariat nationalized the petroleum industry.

rubles was placed at the disposal of the industry, and production plans called for 68.1 million tons by 1937. Actual output in 1937 was, however, only 27.1 million tons. The Third Five-Year Plan (1938–42) called for an output of 47.7 million tons by 1942. Interrupted by World War II, production in 1942 was only 31.8 million tons.

World War II caused a general decline in petroleum production, but by 1947 the downward trend had been arrested. The Fourth Five-Year Plan (1946–50), which called for an output of 35.4 million tons, was a great contrast to the high expectancies of the Second and Third Five-Year Plans and appears to have been based on a soberly realistic estimate of the country's petroleum possibilities. The planned production for 1950 was not only achieved, but actual production of 37.6 million tons exceeded the goal by more than 6 per cent. Although it is not possible to give the individual results with absolute certainty, there is a reasonable basis for assuming that the following figures come close to reality:

PETROLEUM PRODUCTION IN 1950

Petroleum Regions	*Output (Tons)*	*Per Cent of Total*
Baku	17,000,000	45.2
Grozny	1,800,000	4.8
Maikop	1,500,000	4.0
Dagestan	500,000	1.3
Georgia	120,000	0.3
Turkmen	1,250,000	3.3
Ukraine	330,000	0.9
Second Baku (Molotov, Ufa, Kuibyshev)	10,600,000	28.2
Emba	1,300,000	3.5
Ukhta-Pechora	800,000	2.1
Central Asia (Fergana Valley)	1,200,000	3.2
Sakhalin	1,200,000	3.2
Total	37,600,000	100.0

These data show that the strategically vulnerable petroleum fields of the Caucasus still have superiority in the Soviet petroleum industry and are not purposely being neglected, as has been asserted by some commentators.

The rank of a petroleum industry is determined not only by its production capacity; the capacity of its refineries is also of great importance, since crude petroleum cannot be used as it is taken from the well. Complex refining processes are necessary to obtain the end products which modern industry demands.

The refineries that the Soviets took over from the Czarist regime were in part obsolete and in part rendered unusable as a result of the war and the revolution. During the First Five-Year Plan refineries were obtained from abroad, particularly from the United States. Greater efforts were made to expand refinery capacity during the Second Five-Year Plan—new refineries with a total capacity of 7.7 million tons (about 54,000,000 barrels) a year were constructed. At the beginning of the Third Five-Year Plan about 77 per cent of the entire refining capacity was concentrated in the Baku region; 12 per cent was in Grozny, whose refineries also processed crude petroleum from Baku (the Grozny deposits having been greatly overestimated); and 5 per cent was in the Maikop region. In the course of the Third Five-Year Plan refining capacity again was greatly increased. With progressive development of petroleum production in the Second Baku, the Caucasus lost its former unequivocal superiority; new, modern refineries were built in Saratov, Syzran, Sterlitamak, Ishimbai, Tuimazy, Molotov, and Buguruslan. In addition, refineries were also constructed in the centers of petroleum consumption, that is, in Rostov, Stalingrad, Moscow, and Leningrad. By 1951 the Soviet Union had at least 66 refineries of various capacities. The total capacity of all plants is assumed to have been between 33

and 35 million tons (680,000 to 720,000 barrels per day).

Within the total refining capacity and of great importance in the Soviet Union is cracking capacity. Soviet crudes, excepting some from the northern Caucasus, yield under normal distillation only a small percentage of gasoline, generally between 5 and 10 per cent. To achieve a higher gasoline yield, construction of cracking facilities was begun in 1928, and by 1937 the cracking capacity is supposed to have been 9.25 million tons. In 1951 the country's cracking capacity is assumed to have been between 13 and 14 million tons.

A country's petroleum consumption has today become an infallible measure of the technical position of its political economy; from the level of the country's petroleum consumption, and especially from its consumption of fuel oil and lubricants, can be deduced the capacity of industry and the intensity of commerce. The low level of petroleum consumption during the Czarist regime reflected the low level of technical development of the Russian political economy. During the early stages of the Soviet regime, petroleum consumption remained low, while production steadily increased, which gave rise to petroleum exports. Under the First Five-Year Plan petroleum exports grew and reached a maximum in 1932, when more than 6 million tons was shipped out of the country. With the Second Five-Year Plan, however, a basic change took place; a conscious drive developed toward industrialization, motorization, and mechanization, which stimulated the growth of domestic consumption and necessarily brought about a decrease in petroleum exports. Domestic consumption has grown to a point today where it is barely covered by domestic production; for 1950 consumption of petroleum products may be considered to have been between 30 and 32 million tons.

PETROLEUM-PRODUCING REGIONS

Part III, which reviews the individual petroleum-producing regions, begins with a discussion of petroleum, natural gas, and oil-shale reserves. On February 14, 1941, the Soviets introduced five classes of petroleum reserves, which range from those "determined with absolute certainty" to "possible supplies." Hassmann excludes several of these classes because they are too conjectural and concludes that Soviet petroleum reserves (presumably comparable to proved reserves in the United States) total about one billion tons. Natural gas reserves have been estimated by individual Soviet geologists at 700 to 800 billion cubic meters, which should be viewed with a certain amount of caution; but oil-shale reserves of 55 billion tons place the country in a class with the United States, Canada, Australia, and Manchuria as one of the most important oil-shale countries in the world.

The descriptions of each of the individual producing regions generally follow the same pattern—the location and a short history of the region; the controlling trust or association; a listing of the producing fields, with a brief reference to geological features; refineries; pipelines; major features of production; and the transportation facilities. Included are 14 small maps showing fields, refineries, and major pipelines in each of the producing regions.

PROBLEMS OF THE SOVIET PETROLEUM INDUSTRY

In Part IV various problems of the Soviet petroleum industry are discussed. The author believes that the problem confronting the over-all world

petroleum industry—whether petroleum production can match rapidly growing petroleum requirements—also confronts the Soviets. He finds it manifestly difficult, however, to determine the petroleum requirements of the U.S.S.R. The validity of comparing petroleum requirements of other countries, especially the United States, with those of the U.S.S.R. is questioned, because of different economic systems and ways of life. Moreover, a greater part of the Soviet Union's energy demands, which in other countries are satisfied by petroleum, is supplied by coal and electricity. Hassmann claims that, if the increase of world petroleum supply and the increase of world petroleum needs were compared systematically with the performance and requirements of the Soviet petroleum industry without cognizance of the special Soviet economic, political, and sociological relations, a false conclusion would be reached.

The author's determination of Soviet petroleum requirements is predicated on the principle that the petroleum needs in any domestic economy are based on the same factors in all countries, the only difference being the relative importance of each factor. Analyzed are the size of the economic sphere, the number of people, the level of the nation's technology, and finally the nature of the economy. Despite the constriction of civilian requirements, the current mineral-oil needs of commerce, agriculture, industry, and the Soviet army have passed the 40-million-ton mark. To maintain the pace of the aggressive development of its economic policy, the U.S.S.R. must increase its production of petroleum to 60 million tons by 1960, which may be taken to represent the administration's conception of the minimum requirements of the Soviet economy in the next 10 years.

The quantity of petroleum the U.S.S.R. had at its disposal in 1950 totaled about 44 million tons. The separate items are as follows (to facilitate the summary there has been no differentiation between crude petroleum and refined products):

	Tons
Soviet production	
Petroleum	37,600,000
Shale oil	400,000
Synthetics	1,000,000
Total	39,000,000
Soviet imports	
Petroleum	4,000,000
Synthetics	1,000,000
Total	5,000,000
Grand total	44,000,000

A careful evaluation indicates that these quantities have been disposed of in the following manner:

	Tons
Soviet consumption	
Industry	12,000,000
Commerce	10,000,000
Agriculture	9,000,000
Household uses	1,000,000
Soviet army	8,000,000
Total	40,000,000
Exports to China and Korea	4,000,000
Grand total	44,000,000

It may be assumed that the main petroleum demands of Soviet industry have been generally satisfied, but if the tempo of its industrial development is to increase—there is no doubt that the Eastern Block has a variety of raw materials as well as an unsaturated market for them—its future petroleum requirements must be calculated to increase significantly. It should be kept in mind that Soviet industrial production, in relation to the world's industrial production, has sextupled in

the last 40 years—from 2.3 per cent in 1913 to 14.2 per cent in 1950. If this upward development continues and if Soviet industry cannot satisfy its energy needs from other sources, the question of an adequate petroleum supply soon becomes the gravest of problems.

In the western world today the Soviet army is frequently referred to as being "super-motorized"; it is rumored that its petroleum needs, even in peace, can no longer be satisfied. Hassmann claims that such a conclusion has no basis in fact. Of the 175 divisions comprising the Soviet army in 1950, only about 50 were motorized. Because of its extraordinarily long boundaries the U.S.S.R. has divided its land armies into six autonomous groups, which have their headquarters in Leningrad, Minsk, Odessa, Tiflis, Tashkent, and Khabarovsk. Each of these army groups is to carry on independent operations in case of necessity. For such an arrangement to be effective, each must establish a self-sustaining economic basis, and certainly a self-sustaining petroleum basis, if each army group is to be really independent in its supply. If nearly one-fourth of the 1950 total petroleum production had been placed at the disposal of the Soviet army, such a quantity probably would have contributed significantly to the army's stockpile. With stabilization of world peace, it is very possible that the Soviet army could manage with much less.

Space does not permit individual discussion of each of the Soviet petroleum industry's problems as seen by Hassmann, but a listing of the problems indicates the scope of Part IV:

1. The mineral-oil requirements of the Soviet Union.
2. Can the mineral-oil requirements of the Soviet Union be readily compared with those of other countries?
3. Could the mineral-oil requirements of the Soviet Union be constricted without economic-political damages?
4. Meeting the mineral-oil requirements of the Soviet Union.
5. Is the petroleum industry aided or hindered by the Soviet economic system?
6. Do Soviet geological conditions and the personnel situation favor an increase in its petroleum industry?
7. Is the steel supply of the Soviet petroleum industry assured?
8. Can synthetic oil production make a substantial contribution to the mineral-oil supply?
9. To what extent can the Soviet mineral-oil requirements be covered through imports?

THE SOVIET UNION AND THE MIDDLE EAST

The book concludes with a short epilogue entitled "The Soviet Union and the Middle East," wherein the volume of Middle East petroleum reserves is discussed in relation to United States, European, and Soviet interests. Soviet control of this rich petroleum region, which lies directly before the door of the Soviet Union and is currently under Anglo-American control, would solve and settle forever all supply difficulties and petroleum bottlenecks in the Soviet Union. With these considerations in mind, the current troubles in Iran assume an extraordinarily realistic meaning. The Soviets have long attempted unsuccessfully to gain binding petroleum concessions in Iran and consider it to be in the interests of the Soviet Union "to eliminate the Anglo-American sphere of interest in the Middle East." Inasmuch as the Soviet Union is empowered, on the basis of an Iranian-Soviet agreement, to send

troops into the country to protect Iran "as soon as a third power threatens Persian independence," serious entanglements could easily result from these overlapping interests. If the petroleum production of the Middle East is someday added to the Soviet petroleum production, it would result in such an increase in Soviet industrial power that the political future of the world would thereby be changed.

EVALUATION AND CRITICISMS

To evaluate the reliability of this work is, in some ways, nearly as difficult as was its original preparation. Since 1938 no truly reliable data that could be used for comparison and reference have been released. In all fairness, any treatment of a national petroleum industry from its historical foundations to its current problems of such a magnitude as that of the U.S.S.R. would probably touch certain aspects of the industry too lightly to be wholly satisfactory for all readers. Nevertheless, Hassmann's subject is so important that a judgment must be made.

A weighty point neglected by Hassmann is the decreasing importance of petroleum relative to coal in the Soviet Union's Fourth Five-Year Plan. According to the Soviet figures, petroleum production in 1950 was 37.6 million tons and coal production 261 million tons, or 0.144 ton of petroleum per ton of coal. By 1960 petroleum production was to increase to 60 million tons, while coal output was to reach 500 million tons. If these plans had materialized, the ratio of petroleum production to coal output would have been 0.120 ton of petroleum per ton of coal. In other words, the importance of petroleum in the Soviet economy relative to coal would have decreased 16.7 per cent, a trend that is just the reverse of what has been taking place in the world energy picture over the past several decades and what appears to be the trend in the present decade.

These data immediately pose the question of why Soviet economic and industrial planners chose to de-emphasize petroleum relative to coal in the nation's future energy consumption pattern. Answers to such a question are admittedly speculative, but there are numerous reports that the situation in the petroleum industry is troubled. This relative de-emphasis might be due to shortages of such steel goods as drill, casing, and line pipe; to supply adequately the steel requirements of the petroleum industry in the process of rapid expansion may have been considered by the planners as secondary to meeting armament needs. Another possibility is that the Soviet Minister of Petroleum is somewhat reluctant to undertake an increased exploratory drilling program. In any country the increasing of exploratory drilling by itself does not guarantee increased production. The possibility of failure and the disastrous effects on responsible personnel may have led the planners to take a less optimistic position toward petroleum than toward coal, the very nature of which involves less risk in development plans. Moreover, under the Soviet economic system there does not appear to be any provision analogous to risk capital in the United States which has played such an important role in the development of the United States petroleum industry. Nor should the possibility be overlooked altogether that the U.S.S.R. does not have such abundant petroleum reserves as reported so frequently in both Soviet and western geological circles. It should be noted that most of the western evaluations of Soviet petroleum reserves have been based on data obtained from regional geologic studies made before

1938, and very little on data obtained from geophysical work.

Of particular interest is the Soviet Fifth Five-Year Plan (1951–55), which was released during the second half of 1952. By 1955 crude petroleum production is to be 70 million tons, but the 1960 goal for coal production remained unchanged at 500 million tons. Under this plan the position of petroleum relative to coal has been altered markedly and is now more conformable with the world energy pattern. Again, one can only speculate on the reasons for the change. Whether the new planned output of 70 million tons of crude petroleum a year by 1955 has been based on a realistic evaluation of petroleum resources and the ability of the industry to achieve this level, prescribed as a target toward which the industry should aim, or published as propaganda for home consumption, cannot be ascertained. What can be stated, however, is that a much higher production level than that reached in 1950 is imperative if many other parts of the Fifth Five-Year Plan are to be achieved.

For a more balanced appraisal of the ability of the Soviet petroleum industry to meet the requirements of the country, more attention should have been given to the refining problems stemming from the chemical composition of some of the crudes from Second Baku and other eastern fields. Such problems extend into the important question of aviation-gasoline manufacture and supply. Related to these problems are the petrochemical industries, which in the United States are expanding rapidly not only in volume of output but also into the production of vital components for modern warfare. According to J. G. Tolpin of the Standard Oil Company (Indiana),[3] enough information is available on some of these problems to make possible a more balanced treatment.

Among the minor shortcomings of the book is the petroleum supply and disposal balance drawn up for the year 1950. In making this summary Hassmann readily admits no differentiation between crude petroleum and refined products. Sacrificed for the sake of convenience in the summary are the quantities of petroleum used for such purposes as field operations, fuel in pipeline pump stations, and refining operations. In addition are such losses as evaporation losses from storage tanks[4] and those inherent in refining operations. In the United States, where close attention is given to efficiency and economy of operations, such uses and losses normally represent about 6.5 per cent of the year's total production. Balance sheets of the year's operations made up for the entire petroleum industry by the Bureau of Mines, United States Department of the Interior, and the American Petroleum Institute carefully account for these quantities, so that demand or disposal can be calculated with a minimum of error. In view of the numerous reports of Soviet operational inefficiencies and their difficulties in controlling losses both in storing and transporting petroleum, the uses and losses that account for 6.5 per cent of United States annual production may be estimated conservatively at 10 per cent for the U.S.S.R. Soviet consumption and exports to China and Korea total, in Hassmann's summary, 44 million tons, or precisely the same as total supply. Since crude petroleum for domestic, industrial,

[3] *The Petroleum Times*, Vol. LVI, no. 1424, March 7, 1952, London.

[4] Such losses must be sizable, especially in the Baku fields, where crude petroleum is frequently stored in open, earthen pits.

and military uses is not consumed as such but in the form of refined products, the supply and disposal balance as drawn up is impossible.

On at least one point the reviewer believes the author to be incorrect. In Part IV Hassmann discusses the steel requirements of the Soviet petroleum industry and arrives at an average steel requirement of one ton of steel for each 32 tons of crude petroleum produced. In calculating this figure he used the total inland requirements of the United States petroleum industry prepared in 1950 by the National Petroleum Council. The figures appearing in the text (p. 156) are as follows:

STEEL REQUIREMENTS OF THE UNITED STATES PETROLEUM INDUSTRY IN 1950

Uses	*Million Tons*	*Per Cent*
Production	2.8	33.0
Transport	1.4	17.0
Refining	0.5	6.0
Distribution	1.8	21.0
Natural gas production	2.0	23.0
Total	8.5	100.0

Dividing the total United States petroleum production for 1950 (about 270 million tons in round figures) by the total steel requirements (8.5 million tons) Hassmann arrives at one ton of steel for 32 tons of crude petroleum. Included in the 8.5 million tons of steel, however, is 2 million tons for natural gas production, but no corresponding adjustment for natural gas production was made in the crude production total. In the above figures steel requirements for petroleum alone in 1950 were 6.5 million tons. The proper ratio of steel requirements to crude petroleum is, therefore, one ton of steel for 41.5 tons of crude petroleum. Hassmann then calculates 1950 steel requirements for the Soviet petroleum industry, basing the calculation on the 1:32 ratio and a production of 39 million tons of crude petroleum, shale oil, and synthetic liquid fuels. He arrives at a total steel requirement of 1,250,000 tons. Actual steel requirements are suggested to have been somewhat higher, since the industry was undertaking much new construction. As a maximum limit he suggests 2,000,000 tons of steel, which appears to be overly generous in view of the method of calculation. Nevertheless, his conclusion that the Soviet petroleum industry takes a smaller share of the national steel production than the United States petroleum industry takes of the United States total steel production appears to be sound.

Hassmann's work is considered to be a valuable contribution to the meager literature on Soviet industry. With respect to Soviet petroleum, this work is the most complete presentation of its geography and economics known to the reviewer. It should not, however, be inferred that these remarks constitute an unqualified endorsement of the book, for it has limitations, some of which have been pointed out. It is to be hoped that others studying various phases of Soviet industry, particularly the petroleum industry, will examine critically all performance claims before accepting them as accomplishments.

BOOK REVIEWS

Plants, Man and Life, by EDGAR ANDERSON. 245 pp.; diagrs., index. Little, Brown and Company, Boston, 1952. $4.00. 8 x 5¼ inches.

Plant geography has been neglected by geographers. By default they have let this field go to the ecologist and to the botanist. But there still remain considerable areas where geographers could do interesting work that would be somewhat different from that of either the botanist or the strict ecologist. The vacuum that we have left is being filled by historico-ecological, ethno-botanical, and other such compound studies. Recent examples of such studies that should be of top interest to most geographers would be: the historian Malin's studies of the American grasslands; Beilmann and Brenner's "The Recent Intrusion of Forests in the Ozarks"; J. Sauer's study of the grain Amaranths; Castetter and Bell's study of the ethnobotany of the Yuman Indians; and, last but not least, *Plants, Man and Life* by Edgar Anderson.

Anderson is a botanist, a taxonomist, and a natural scientist whose areas of interest expand almost indefinitely to include a good deal of history, archeology, and human ecology. In his present book he has chosen to write for the intelligent laymen (an apt description of most of us geographers in the field of botany), and the result is a readable and informative book. In it, in most informal style, he discusses such things as the European plants in the United States, and how, by such things as different reactions to this climate from that of the native plants, they give a special mark to the landscape. (What are climate and landscape doing in botany? Don't we geographers own them?)

In the history of weeds, geographers will find Anderson using areal and habitat distribution studies to get at the causes of differentiation in plants. Nowhere could one find a more painless introduction free of horrendous jargon that usually prevents geographers from having any concept of what botanical plant geographers think about.

But all of the chapters are equally simply and attractively written. In "The Clue from the Root Tips" one will find a painless and enlightening illustrated statement on the role of genetics in the plant field. "How to Measure an Avocado" introduces the problems of measurement and scoring of complex traits. Economic geographers could learn much from Anderson's ingenious solutions of portraying on one scatter-diagram as many as three grades each of three related variables. "Uneconomic Botany," "Dump Heaps and the Origin of Agriculture," "A Roster of Our Most Important Crop Plants and Their Probable Origins"—suggest more of the wide range of material covered.

Within this one small book geographers will find breadth of knowledge, as well as great skill in use of such formidable fields as taxonomy, statistics, ecology, genetics, and evolution, combined with a most readable style to give them an introduction to one of the neglected fields of geography.

GEORGE F. CARTER

Johns Hopkins University

An Introduction to Human Geography, by J. H. G. LEBON. x and 191 pp.; maps, bibliogr., index. Hutchinson House, London, W. 1, 1952. Text edit., $1.80; trade edit., $2.25. 5 x 7½ inches.

A puzzling book! Its title covers the field of human geography, and the author begins by remarking that he must be "severely selective." Since there are but 172 small pages of text and illustrations, including end-paper maps, the reader can only agree. This reviewer, to his regret, has been unable to discover the basis on which selection has been made, either with respect to subjects discussed, cases chosen to exemplify them, or level of treatment.

The title of the volume addresses the geographically untutored. However, such readers are likely to be discouraged by the technical section on physiological climatology in Chapter 2, and they will receive little aid in visualizing the combinations of natural elements that make up the several environments catalogued on the early pages of Chapter 4. Persons more widely read in geography will generally find themselves traversing very familiar ground, notably in the half of the book between pages 49 and 130. Indeed, they may feel that several concepts and conclusions stated as certainties repeat views that are now either rejected or disputed. To be sure, generalizations in a work so comprehensive, and intended for the layman, cannot always be guarded with modifications the specialist would

like to see. But it is only fair to the untrained reader to state questionable judgments as hypotheses or assumptions.

Not all the major topics are given separate chapters, and their treatment ranges from taut to slipshod. Chapter 1, on the evolution of geographic thought, is a crisp piece of scholarly compression readily comprehensible to the beginner and at the same time valuable to the advanced. In contrast, the final chapter abandons the sweeping universals of the rest of the book to treat haphazardly of parts of Africa, including a stereotyped résumé of physiography, and a rambling excursion into history that would be out of place in a large volume devoted exclusively to the geography of that continent. The long chapter "Environment and Economy" includes a wide range of topics, variously treated. Its last 20 pages freshly and provocatively discuss "Limits to the Spread of Economies," but they are preceded by a stale, 50-page survey of human economies from their hypothetical beginnings that heavily accents the primitive economies by allotting to them six out of eight types.

The emphasis throughout is on geography of the past: primitive societies, historical evolution, and the role of nature in simple societies and their migrations. This fulfills half of the promise in the title of Chapter 1—"Tradition and the Modern Conception of Geography." The importance of traditional items in the geography of today is great (and too often neglected in the United States). The other half of the promise is not fulfilled, and the reader is left in doubt as to what the modern conception of geography is. Perhaps the explanation is given in paragraph 2 of the preface, which announces a definition of human geography as being "not one that is generally accepted among geographers." Certainly it is one the reviewer has never before run across in forty years of geographic pursuits.

The paucity of maps (six) is excused on the ground of cost, and the reader is referred to an atlas of the type used in college courses. Perhaps the British reader will be familiar with such an atlas, but Americans likely to peruse a brief and inexpensive introductory book will be most unlikely to arm themselves with a six-dollar technical manual they have never learned to interpret. The choice of maps that are included is a further cause of puzzlement. Two refer to special cases of medium and small areas; why were they chosen among hundreds equally illustrative? The rest are, appropriately, world-maps. "The Distribution of Malaria" calls attention to an important, if restricted, item of the natural environment, but there must be scores of maps more appropriate and useful in a book on human geography than "The Conjectural Vegetation Zones During the Würm Glaciation."

DERWENT WHITTLESEY

Harvard University

The Economic Development of Iraq. Report of a Mission organized by the International Bank of Reconstruction and Development at the request of the Government of Iraq. xix and 463 pp.; maps, tables. The Johns Hopkins Press, Baltimore, 1952. $5.00. 8¾ x 5¾ inches.

This book is one of a series of reports of the General Survey Missions, published for the International Bank for Reconstruction and Development by the Johns Hopkins Press. Other volumes include reports on Colombia, Cuba, Guatemala, Turkey, Surinam, and Ceylon. The survey mission for Iraq was organized at the request of the Government of Iraq and carried out its work in Iraq during the spring of 1951.

It should be borne in mind, that this mission not only acted at the request of the Iraqi government, but that it had to find the answers to very specific questions. These terms of reference are given in the preface as follows: "The Mission will be expected to undertake a general review of Iraq's economic potentialities and to submit recommendations designed to assist the Government of Iraq to formulate a long-term program for the further development of the country's productive resources. Specifically, the report of the Mission is to include recommendations concerning: (1) investment priorities as among different sectors of the Iraqi economy and as among types of undertakings within each important sector; (2) the approximate rate of investment which can appropriately be undertaken without inflationary or other disruptive effects; (3) measures apart from capital investment which appear necessary or desirable for improving and increasing production; (4) economic and fiscal policies which may be important to accelerate the pace of Iraq's development; and (5) governmental organization and practices having an important effect on development."

In view of the limits set by this mandate, the report cannot be expected to be anything like a complete regional economic geography, where all the different aspects are given the same weight. Some questions receive full and very detailed treatment, while others are willingly and for obvious reasons neglected. This is particularly true with respect to physiography, climatology, etc. From a geographer's point of view it seems highly debatable whether this is justified. Even if the questions submitted to the mission may at first sight not demand a full discussion of the physical facts of the country, it may very well be that a discussion of the mission's findings and recommendations and perhaps of recommendable changes cannot be carried out without a full knowledge of such facts. It seems not enough to supply to those who use such an important report only such facts as have an immediate bearing upon the

problems discussed; specifically, in a case like Iraq, where documentary material is scarce, very often not available, or its use restricted, it would seem appropriate, to have included a short chapter supplying factual knowledge of the country's physical set-up. This criticism seems even more justified in view of the absence of a bibliography or of any reference to bibliographical sources where the reader might find additional material, enabling him to evaluate objectively the recommendations of the mission.

This being said, we may however give full recognition to the immense and invaluable information contained in the report. It is arranged in two parts of different length. Part I is the report proper (pages 1–120), while Part II covers as "annexes" pages 121–463. Since the annexes supply much of the factual material basic to Part I, the organization of the text of the two parts runs in many respects parallel. The main chapters of Part I are Introduction, Agriculture, Industry, Transport and Communications, Public Health, Community Planning and Facilities, Education, Problems of Execution, Impact of the Program, Conclusion; Part II is divided into annexes A-H as follows: Basic Factors and Conditions; Flood Control, Irrigation, and Drainage; Agriculture and Animal Husbandry; Industry; Transport and Communications; Public Health; Education; Community Planning and Community Facilities. Sixty tables giving up-to-date statistical data ranging from the salinity of the Euphrates and the Tigris to land classification, official exchange transactions, and cases of eye diseases—to name but a few of the topics—are a source of information not to be found in any other publication.

Within the space of a review it is impossible to discuss at length any of the many topics considered in the book. However, a few indications may be given. For the past 20 years the income of the Iraqi government from the oil industry has been rather small, because the crude production was only 4 million tons when the two pipe-lines to Haifa and Tripoli were in operation and only 2 million tons after the closing of the Haifa line. However, in August 1951 the Iraq Petroleum Company undertook to raise oil output to 30 million tons by the end of 1955 and to turn over to the Iraqi government half of the profits before the deduction of taxes. This will increase the government's income from oil to 59 million £ in 1956–57 or about to 214 million £ for the period 1952–53 to 1956–57. If oil production is actually going to be increased at the planned rate, the financing of any development program by the Iraq Development Board (an agency established in 1950) seems therefore to be assured, except for the fact that all these revenues will be received in the form of sterling. The government will, however, encounter great difficulties in spending this money in such a way that the national economy is not abruptly and disturbingly changed. Difficulties in spending may also arise from the scarcity of certain materials, such as steel or machinery, on the world market. We have, therefore, the rather unique case that the main problems are not concerned with financing but with spending. The recommendations of the mission give an estimated outlay for a five-year development program, beginning with the fiscal year 1952–53, totalling 168.5 million £. Of this 55.2 million £ will be for flood control, irrigation, and drainage; 7.5 million £ for agriculture and forestry; 37.0 million £ for industry (refinery, chemical plant); 31.0 million £ for transport and communication (15.1 for railroads and 11.0 for roads); 23.2 million £ for community facilities (water supply, sewage system); 6.1 million £ for education; 5.0 million £ for public health; 3.5 million £, miscellaneous and administration.

This book is far more than an invaluable source of information on Iraq and of technical problems such as irrigation, agriculture, etc.; it offers to the student in economic geography a highly illuminating discussion of the far reaching economic problems that arise in the Middle East through the rapidly increasing revenues from the oil industry.

HANS BOESCH

University of Zurich

A Kansas Atlas. Edited by ROY H. JOHNSON and CHARLES J. SMITH. Cartography by GEORGE F. JENKS. 32 pp.; maps, charts, tables. Kansas Industrial Development Commission, Tokepa, Kansas, 1952. 15 x 10½ inches.

A Kansas Atlas is frankly designed to present facts concerning Kansas in their most attractive light, with a view towards attracting industry to the state. As such, it is an interesting example of cooperation between geographers of the University and members of the Kansas Industrial Development Commission. The editors are members of the Commission. The cartography and the geographical research were done almost exclusively by geographers at the University of Kansas. The atlas is therefore worthy of notice not only as a good example of cartographic work but also as an example of a job which geographers can do to promote the interests of their state and in so doing gain additional prestige and support among the citizens of the state for the profession of geography.

The atlas is valuable for students and instructors of cartography because it illustrates a variety of symbology effectively used. Throughout, there are frequent changes in the kinds of symbols used and of course in coloring schemes as well, so that the series of maps presents a

good survey of different cartographic techniques. The cartographic work is superior in quality, color combinations are effective, and the maps are adequately supplied with legends and are easily read. The cartography was planned and either executed or supervised by Dr. Jenks.

The plan of approach is simple. It consists of a series of maps relating to the physical and human geography of Kansas, accompanied by text material and by various tables and charts. There are groups of maps portraying climate, soils, water, minerals, fuels, power, transportation, population, agriculture, the processing of agricultural products, manufacturing, trade, education and health, and a single map showing recreational facilities, as well as one giving the location of Kansas relative to the United States as a whole and an index map of incorporated places.

Certain ones of these maps are particularly good for their detailed coverage and for a higher degree of accuracy than is often possible to achieve. The makers of the atlas had at their command the Kansas Statistical Rolls, which give much the same type of information as would an annual state census, the information being collected by the personal property tax assessor. The availability of highly detailed material assembled by political townships made it possible to draw the boundaries for the map "The Geographic Pattern of Kansas Agriculture" more definitively than would ordinarily be possible. Of notable interest also is the "Population of Kansas" map. By using the Statistical Rolls, it was possible to show "Incorporated Nucleated Population," "Unincorporated Nucleated Population," and "Dispersed Rural Population," so that the extent and shape of the suburban areas are shown distinctly and assume their proper position as extensions of urban areas rather than as rural population.

The style of the text is keyed to popular appeal. As the atlas was designed to attract business and industry to Kansas, naturally the facts are presented in glowing terms. It is inevitable, also, that some phases of the geography of the state should be omitted or glossed over in a work of this type. For instance, the recurrence of drought is not brought out, erosion problems are touched upon only lightly, and the loss of population in some areas is not discussed. As a piece of geographic research, the atlas of course suffers from these omissions. However, it must be kept in mind that it was planned with a certain objective. It has met this objective well. Moreover, in spite of the incomplete coverage of certain topics, there remains a considerable amount of information of value not only to prospective investors but also to the student of the state's geography.

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Types of Farming in Scotland, by P. M. SCOLA and A. M. MACKENZIE (Department of Agriculture for Scotland). 102 pp.; maps. Her Majesty's Stationery Office, Edinburgh, 1952. $0.50. 9½ x 6 inches.

The planned economy of Britain ideally requires considerably more information on the organization of farming units and the distribution of the various types of farms than has heretofore been available. In Scotland prior to 1951 prices were fixed and production policies established on the basis of such small samples that some check on their reliability was obviously necessary. Scola, a geographer, and Mackenzie, an agricultural economist, were selected by the Department of Agriculture for Scotland to prepare an economic classification of Scottish farms which could form a basis for agricultural policy. The resulting study is of interest to geographers not only as a major contribution to our knowledge of Scotland but also as a contribution to geographical methodology.

Scola and Mackenzie first prepared an empirical economic classification of Scottish farms in terms of their livestock production policy, since livestock traditionally account for three-quarters or more of Scottish agricultural output. The livestock production policy of each farm was then determined from data collected for the Agricultural Censuses of December, 1946, and June, 1947, and the farm was classified into one of eight major groups. The criteria for classification were relatively complex combinations of livestock numbers, land use, and sales of farm products. A farm with more than 400 breeding ewes, for instance, could not be classified as a hill sheep farm if it had more than 20 cattle per hundred ewes or if it had more than three acres of a feed crop, such as rape, per hundred ewes. In other words, the farm, as an organized unit of agricultural production, was classified in terms of what it was organized to produce, as revealed by the census data for the farm. Such a classification obviously transcends a classification in terms of one single criterion, such as livestock numbers, crop acreages, or even value of farm production. Two major obstacles, of course, would normally prevent the individual research worker from undertaking such a classification. Census returns are customarily confidential (although the British have a much better record than we of making confidential census material available to the qualified student), and even were they not, the analysis of some 78,000 individual returns would require a large clerical staff. Such a staff presumably could only be mobilized by a government agency, so it is to be hoped that agricultural departments outside Scotland may be stimulated to similar good works.

The geographer who knows Scotland will not be surprised at the eight major farming types, which are: (1) hill sheep farming, (2) stock

rearing, (3) stock rearing and feeding, (4) cropping, (5) dairying, (6) dairying with hill sheep, (7) horticultural, and (8) intensive livestock. The omission of crofting is due to the fact that this study considered only full-time farms. The lower limits, in terms of man-hours per year, were 600 for part-time farms and 1800 for full-time farms, although it was felt that some underemployment existed on full-time farms requiring less than 2200 man-hours per year. It is regrettable that the smaller farms could not have been studied in more detail, since they total 40 per cent of all farms in Scotland and more than two-thirds of all farms in the Highlands, but their small total acreage makes their omission understandable.

The useful booklet which sets forth the results of this analysis has an initial chapter describing the methods used. The second chapter contains general data on the distribution, size, cropping, stocking, tractors and horses, and labor of the full-time farms. Each of the eight major farming types is treated separately in Chapters III through X. The general character, organization, and mode of operation of each farming type is discussed, and pertinent statistics are presented in tabular form with regional breakdowns. Each chapter also has a useful dot map with one dot representing each farm of that type in Scotland. The two final chapters deal sketchily with small farms and with multiple-farm units. Appendices provide data on the average rent, cropping, and stocking of each type of farm, the total number of each type, by regions, and the empirical definition which was used in classifying them. A folding black-and-white map in the back of the booklet shows the distribution of Predominant Farming Types in Scotland at a scale of about 1:1,250,000.

It is to be regretted that there are no dot maps to show the distribution of smaller farms; even more that the expenses of reproduction would not permit the crofting areas to be shown on the map of Predominant Farming Types, which is nonetheless a very valuable contribution to British geography. The authors have also prepared a manuscript copy of Sheet One of the Types of Farming map (1:633,600) originally prepared by the Ministry of Agriculture and Fisheries and published by the Ordnance Survey under the auspices of the Land Utilisation Survey. The old map was drawn subjectively by the agricultural economists of the various regional agricultural colleges in Britain. Its lack of objectivity is nowhere better revealed than in the Border Country, where the "agriculturally unproductive" land of England becomes one of the better "hill sheep farming" areas of Scotland. It is to be hoped that the Ordnance Survey will soon publish the new version, which removes this and other incongruities.

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The Mineral Resources of the World (Vol. II of Atlas of the World's Resources) by WILLIAM VAN ROYEN and OLIVER BOWLES in collaboration with ELMER W. PEHRSON and the staff of the Economics and Statistics Division of the U. S. Bureau of Mines. ix and 181 pp. Published for the University of Maryland by Prentice-Hall, Inc., New York, 1952. $8.00. 15½ x 12½ inches.

Production and use of the world's minerals have been increasing at a phenomenal rate. In fact the picture has been changing so rapidly that only experts in the minerals field have been able to keep abreast of what is happening. Now in *The Mineral Resources of the World* the story has been brought up to date in graphic and text form. Few books have been more welcome.

The new minerals atlas is not the first American work of its kind. Shortly after World War I the United States Geological Survey issued its *World Atlas of Commercial Geology*, in two volumes. One of these dealt with minerals, and the second, smaller volume dealt with water power. The Survey's minerals atlas was an exceedingly valuable contribution, but of course it is badly out of date.

Now, 30 years later, its successor has appeared. The new atlas is issued by a commercial publisher rather than by the Government, and there is no reference in the Preface to the book's notable predecessor. Nevertheless, comparison with the earlier minerals atlas is inevitable, both as to format and as to the facts presented.

There is, first, the matter of personnel. Though the authors of individual chapters were not shown in the 1921 atlas, they were listed as a group as "geologists and others." This dominance of geology reflects the fact that the collection of mineral production statistics was then the work of the United States Geological Survey. No reference was made to mineral economists though some of the names on the list were those of men who were coming to be known in that field. No geographer's name appeared among those responsible for the early atlas.

The new *Mineral Resources of the World* was prepared under the auspices of the Department of Geography at the University of Maryland. The book is dedicated to Dr. O. E. Baker, long head of the Department at Maryland and originator of the project for an Atlas of the World's Resources of which the present book is Volume II (Volume I, dealing with agricultural production, is due out this year). Professor Van Royen, present head of the Department, is editor of the atlas series. He was assisted in preparation of the minerals atlas by Dr. Bowles, formerly chief of the Non-metals Economics Branch of the United States Bureau of Mines. Elmer W. Pehrson, chief of the Economics and Statistics Division of the Bureau, collaborated with them, and members of Pehrson's staff prepared most of the individual commodity sections.

Dr. John W. Frey of the American Petroleum Institute, a geographer by training, wrote the section on petroleum; and Dr. Benjamin E. Jones of the United States Geological Survey prepared the material on water power. The chief cartographer of the Department of Geography, University of Maryland, was largely responsible for the map work.

The topical coverage in the new atlas is about the same as that of the old. A Preview is followed by sections on Coal, Petroleum, Water Power, Iron Ore, Manganese, Nickel, Chromite, Tungsten, Molybdenum, Vanadium, Bauxite, Copper, Lead, Zinc, Tin, Mercury, Gold, Silver, Platinum-group Metals, Uranium, Radium and Thorium, Phosphate Rock, Potash, Sulfur and Pyrites, Salt, Diamond, Asbestos, Fluorspar, Graphite, and Mica. Neither in this list nor in that of the older atlas are all commodities covered; that would be an impossible task. There are some notable changes, however. Nitrates were discussed in the earlier atlas but are omitted from the present one, a change that probably reflects the increased relative importance of synthetic as compared with mineral nitrates. On the other hand the new atlas includes a section on Uranium, Radium and Thorium, in response to the rise of atomic energy.

The maps in the new atlas, some 125 to 130 in number, are more diverse than in the earlier product and clearly represent more of a cartographic effort. The most common type is a world map, but there are numerous larger scale maps of countries and of mineral producing districts. To the reviewer the printing seems unfortunately small on some of the maps. This, however, is a minor reproach. The cartographic job, in general, is excellent. It has not been possible to use colors as in the earlier, government atlas, but this could hardly be expected in a commercial atlas that covers only a part of the world's economy and hence will be somewhat restricted in sales.

The coverage for each mineral product is more elaborate than in the earlier minerals atlas. The subheads for one mineral commodity, Manganese, will give some idea as to the detail. A short introduction is followed by: Occurrence (geology); Production and beneficiation; Nationality of control; Reserves; World production; World trade; Consumption; Marketing; Tariff and price. This, and each of the other commodity treatments, is followed by a list of references.

There is, of course, a considerable difference in the detail and other phases of treatment depending upon the commodity and doubtless upon the individual author. Note, for example, Petroleum. After an introduction, these subheads follow: Early records of occurrence; Conditions of occurrence; Relationship between rocks and oil wells; Drilling for oil and obtaining possession; Finding oil; Methods used to tap reservoirs; Ownership and production; Number and age of United States oil wells; Volume and price; Production and demand; Liquid products of gas fields; Lifting and recovery by secondary methods; Separation of oil mixture in field; Transportation; Refining; World reserves; Nationality of control; Production and refining (a long section giving details by countries); and The world problem. This chapter is illustrated by 13 maps, ranging in scale from world maps to one of the Caucasus oil fields.

Water Power, which formed a separate volume of the 1921 Atlas, is here treated in 17 pages including 17 maps. Some of the latter are among the most striking illustrations in the book.

In the production of an atlas the question invariably arises, what year or years will give the most reliable picture? In the United States Geological Survey atlas the world maps were based on data for 1913, "the latest normal year," though 1918 statistics were used for the United States maps. In the new atlas the production data presented on the maps are the "averages of three representative years, generally a prewar year, a World War II year, and a postwar year." On most of the world maps they are shown as percentages of world production.

Any book that attempts so much is sure to suffer from errors of fact and from mechanical errors. In the latter category are some mistakes in references to figures. On page 40, the reference to Figure 1 should be to Figure 40; on page 95 the references to Figures 95 and 96 should be to 93 and 94; and on page 113 the reference to Figure 117 should be to Figure 119. Though such errors are unfortunate they can easily be corrected in a second printing.

The new atlas will have, of course, a tremendous reference value to geographers, geologists, economists, and many others. It will be the standard source of mineral production information for years to come. And it should have more than reference value. A book such as this should generate courses in mineral economics and in the geography of mineral production where such courses are not already being offered.

The reviewer would like to end with a note of hearty endorsement. A new minerals atlas has long been needed, and it is good for the cause of geography that geographers have played so important a role in the preparation of this excellent volume.

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